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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The Registered Office and Laboratories of the B.C.I.R.A. are at:—
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Telephone: Central 1885. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

Forthcoming Events.

OCTOBER 13.

Institute of Metals (London Section):—Ordinary meeting in London. Address by S. L. Archbutt.

Institute of Metals (Birmingham Section):—Symposium on Hardness Testing.

OCTOBER 14.

Institute of Metals (Sheffield Section):—Chairman's address on "Annealing," by Capt. F. Orme, M.Met.

OCTOBER 19.

Institution of Welding Engineers:—Ordinary meeting in London. "The Radiographic Examination of Welds," Paper by R. A. Stephen, M.Sc.

Institute of British Foundrymen.

OCTOBER 13.

London Branch:—Ordinary meeting. "Some Observations on the Character of Cast Iron," Paper by A. C. Vivian.

Crucible Furnaces.

The amount of published information on crucible furnaces is small, possibly because by the time that metallurgical literature had grown the crucible furnace had, to a large extent, already been supplanted. Present conditions suggest that it may still have a sphere of usefulness before it. For making small experimental melts or trials of new types of material it is very convenient, for quantities can be dealt with much smaller than those which require to be put through the cupola. Furthermore, the difficulties due to oxidation and imperfect mixing can be more readily avoided.

In another direction also it is quite possible that the crucible furnace will come back into the foundry for actual production work. Many founders are realising that the possibility of growth of their business depends on specialising, and this often necessitates the manufacture of mixtures different from those which normally go through the cupola. In such work it is often necessary to begin with small quantities. The cupola is particularly difficult to deal with when only small charges require to be melted. In the first place if a small charge is put through by itself there are usually difficulties due to excessive oxidation and the bed requires to be repaired before further work can be done. If several charges are put in and separated by means of a blank charge of coke there is some possibility of contamination between one charge and another.

The cost of crucible melting is, of course, greater than that of cupola melting, but it frequently happens that the prices obtained for special castings permit of this extra cost, and particularly when allowance is made for a measure of uncertainty which frequently accompanies cupola melting with respect to composition. These furnaces can be heated by coke, gas or oil, and charges can be dealt with of a size too small not only for the cupola but even for ordinary oil-fired or pulverised fuel-fired furnaces. Many foundry metallurgists have in recent years been able to obtain crucible-melting facilities and those proprietors whose business development is likely to be added by such a furnace can be recommended to install one with confidence. While crucible melting is about as mistake proof as any foundry-melting operation can be, it must not be supposed that it is entirely so. The difference in melting point between charge constituents, the possibility of oxidation, the question of the best type of crucible, the question of fluxing, and so on, all require consideration and well repay expert advice.

A Rider.

It is common knowledge that the steel-foundry industry, through its employers' federation, is making strenuous efforts to rehabilitate commercial prosperity by acquiring by purchase excess production capacity. The methods proposed are economically possible and theoretically sound. In general, they follow the principles established for the amelioration of the shipbuilding industry, and involve purchase and dismantling. But is this sufficient! After all it does not cost a fortune for the establishment of a new works or the extension of an ironfoundry to include the manufacture of steel. Actually and concurrently with these negotiations, an existing ironfoundry has launched a steel-castings department by utilising its excess iron-melting capacity. This particular foundry possesses a pulverised fuel-fired rotary furnace which is easily capable of making steel at competitive prices judged even by the present ridiculously low level to which they have fallen. We were discussing this problem with a prominent steel-castings manufacturer only last week and we put forward his theory as being a rational solution to the problem. He fears that the buying of excess capacity, *per se*, is insufficient unless accompanied by political agitation with the object of making it the law of the land that a licence is necessary before anyone can start up a steel foundry, and to procure this the promoters must show that they are in a position to give better service than those already established. Political action is always difficult, but has a much better chance of sympathetic hearing and action when the demand is nation-wide. As this factor also affects the iron and non-ferrous sections of the industry the proposal would have a better chance of getting on the statute book if it were sponsored by that nebulous all-embracing foundry employers' federation which we have so consistently advocated for so many years. Foundry owners have been far too modest in the past and it is high time they co-operated to make themselves felt as a real live political force. There is, of course, a very real objection to this licence scheme, and that is that this country requires less and not more Governmental interference with business.

C

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A Foundryman in Canada.

To the Editor of The Foundry Trade Journal.

Sir,—For anyone doing business with Canada there is nothing like going to see for yourself. Wonderful hospitality awaits anyone from the Old Country, and the party of 130 mechanical engineers, of which I was a member, were welcomed with open arms. The night before leaving Canada for U.S.A., inspired by the so recently concluded Ottawa Conference, the opportunity was taken to have a general discussion with the Canadian engineers as to the possibility of our finding more outlet for our goods in their markets. There was much plain speaking, and, after all, it is our best friends who tell us our faults. Yes, they made us feel that their friendship was too sincere to be left at mere talk but must be given effect. There is no doubt whatever that Canada would prefer to deal with England rather than be Americanised, but it is so much a matter of taking the line of least resistance. One might imagine from what was said that the English are the most awkward people on earth to do business with. It is essential to talk the other man's talk and see things from the other man's point of view and for this a good deal of imagination is required.

No doubt the Canadian buyer has been hopelessly spoilt by being waited on hand and foot by the American salesman; and, note well, the American service man. Agreeable or disagreeable, such are the facts; business may be done on these lines with charges accordingly, but buyers will not put up with inconvenience. Also, they demand to know everything before they order, almost more than you know yourself, and a reputation here at home counts for nothing with them.

Canada is a land of water power, electricity and huge expanse, and, although she is suffering intensely from the world depression, her resources are enormous and prosperity will inevitably return. She is suffering from the growing pains of youth rather than the convulsions of final demise. Stupendous preparations have been made as it were, to welcome the millennium which, if not duly to hand to schedule time, will cause a most extraordinary amount of inconvenience.

We were amazed, as, no doubt, it was intended we should be, at the lavish expenditure everywhere displayed. At the outset we found Quebec dominated by the C.P.R. Hotel which must have cost a fortune to build and, apparently, must continue to cost fortunes to maintain. Similarly, on departure at New York the tallest building there aroused the same thoughts. Are magic agencies at work, we wondered; if not, where does the money come from? We were tremendously impressed by the colleges, research laboratories and government buildings; so much so, indeed, that we began to have a feeling that the majority must have a university degree and hold a government appointment.

We, of course, inspected many works, and here we saw nothing but tragedy; as a fair and serious estimate, I should say that, of all the machinery we saw, more than 90 per cent. was idle. I am not clear what has happened to the workers; at least, they have no Labour Exchange around which to congregate. Some workers voluntarily stand off for a few weeks to give their fellow-workers a turn. On the notice boards of one large works I saw posted up a request for cast-off clothes and boots to be left with the caretaker for those out of work, alongside was a notice offering the employees special terms for membership in the local Automobile Club. But that is nothing; everyone has a car in Canada, and a big one, too; nor is the expense very great. I was struck by the excellence of the main roads; the official speed limit of 35 m.p.h. is well advertised outside the precincts of the towns, yet every facility is afforded for doing 70 m.p.h.

It always has to be kept in mind, when thinking of Canada, that the majority of the people in Quebec are French, loyal subjects though they are to the King. They form a valued section of the community, and I venture to think that Canada has there a body of orderly and well-conducted people of which other countries may well be envious. Unfortunately we must hold ourselves responsible for a substantial proportion of the undesirable population. For a long time we cherished the delusion, at the expense of our neighbours, that a bad man deported was automatically reformed. It is common knowledge that when jobs were going it was quite the custom to state "No Englishman need apply."

We fittingly finished up our visit to Canada with a week-end at Niagara, in the presence of one of the grandest spectacles in the world. It is not so much the size of the Falls that impresses as the continuity; it never stopped, and, in the absence of news, I suppose it is still discharging its 756,000,000 cubic feet of water per hour ceaselessly day and night. Incidentally we inspected the power house, in which the water develops 500,000 horse-power.

I have little enough qualifications to write of Canada, but still less of America, where we only spent four days. Everything was much the same including the welcome, including the display and including the shortage of work. I judge the chances of opening up business to be less in U.S.A., owing to the rate of exchange and the greater industrial development. Canada is a mild mixture compared with America, where we heard that notices in one engineering works nearby had to be put up in five languages, and I can well believe it.

The grand climax of New York, where our trip ended, came all too soon, the speed was terrific, of which the crescendo was the syrens of the police escort that took us across the city at 40 miles an hour, in defiance of all traffic signals and rules, just to show what can be done in a land of liberty for people of importance.—Yours, etc.,

Kenneth S. Jewson.

September 27, 1932.

A Proposed British Foundry Technical Training College.

To the Editor of The Foundry Trade Journal.

Sir,—May I have the privilege of endorsing one of the Editorial articles in your issue of the 6th instant with regard to Mr. V. C. Faulkner's proposals for a British Foundry Technical Training College. The need for facilities for an adequate *ad hoc* foundry education has been felt for many years, and was a subject in which, personally, I have been actively interested.

My ambition was not able to materialise until I had the privilege of being appointed Principal of the Constantine Technical College, Middlesbrough, at its inception in 1928, and received the whole-hearted and enthusiastic support of the foundries of the district. With their help a full-time day course extending over two years was commenced in 1930, and, though not so ambitious as Mr. Faulkner's scheme, it more than covers all his essentials. In the curriculum all the normal subjects required for general founding are taken by the students, including pattern-making, and in founding proper instruction covers steel, cast-iron and non-ferrous foundry work, including chill castings, pressure and gravity die castings, in addition to sand castings.

For the purpose of this course the College was deliberately equipped with a cupola, a high-frequency melting furnace, core stove, etc., in addition to a very well-equipped pattern shop; the adjacent metallurgical laboratories are well equipped as any in the country for pure metallurgical instruction, including calorimetry, metallography, etc.

The course provides facilities for all the students to spend one half-day each week receiving practical instruction in the works of the local foundries, and the whole curriculum and training is reviewed annually by an Advisory Committee carrying representation from the Institute of British Foundrymen, the Iron and Steel Institute, the Institute of Metals, the British Cast Iron Research Association and the British Non-Ferrous Metals Research Association.

I quite agree that a scheme somewhat on the lines suggested by Mr. Faulkner is bound to come if this country is to maintain its status in foundry matters, but, at the same time, I fully support your contention that the time is not ripe for such a scheme, and I would strongly urge the Council of the Institute of British Foundrymen to support the scheme at Middlesbrough, where the staff, curricula, equipment and facilities are already in existence without needing any further immediate expenditure, and to gain experience from the existing scheme before launching out on anything very much larger.—Yours, etc.

Douglas H. Ingall.
British Non-Ferrous Metals Research Association.

Regnart Buildings,
Euston Street,
London, N.W.1
October 10, 1932.

Random Shots.

As a result of "Marksman's" comments last week on the rubber truncheon, two letters have been sent to him on the subject of bandits and the motorist. One of them harps on the "why doesn't somebody do something about" note, and ought to have been addressed to the correspondent's local Member of Parliament, or better still, not addressed to anybody. The other offers some alleged practical suggestions for dealing with the modern gentleman of the road. "Could not," asks the author of the letter, "some device be incorporated in the design of the motor car whereby, when a lever is pulled, two steel arms swing out from the body and firmly grip the bandit around the elbows, so rendering him powerless." The merit of this device, it is pointed out, is that if every car were fitted with bandit-catching arms, the amount of steel required would undoubtedly result in an improvement in the steel industry.

* * *

To "Marksman's" mind, however, the gadget is too much in the "Heath Robinson vein" to be really effective. The steel industry will have to struggle along manfully without the added demand of material for steel arms. A second suggestion put forward by the correspondent is that a large spring, in compression, and having a boxing glove attached to the working end, should be housed inside the car; when a button was pressed a flap in the side of the car would be raised, the spring would shoot out and the boxing glove would hit the bandit in the pit of the solar plexus. When "Marksman" was a small child, and bought comic-picture papers, he used to see this idea exploited in the "comic strips" at least twice a week.

Marksman.

(Concluded from previous column.)

The magnetic method of testing for weld defects is the simplest and most generally applicable test. It will detect cracks and poor fusion on or near the surface; it shows up best on smooth, level surfaces.

A Conservative Industry.

LONDON FOUNDRYMEN'S VIEWS ON FOREIGN INFLUENCES.

The Chairman (Mr. Lambert) expressing his personal thanks for the Address,* said that it deserved to rank as a classic. Mr. Sommerfield was a very busy man, in view of his many interests, and in penning such an address, which disclosed very high literary ability, apart from the value of the matter it contained, he had proved himself a genius.

There were many points in the address in regard to which the chairman agreed heartily with the President. Discussing the question of opportunities for young men in this country to acquire the knowledge which would enable them to reorganise a works, whether it be a foundry, an engineering department or anything else, he said he considered that such opportunities were lacking. In this connection he recalled a conversation he had had, when in the United States of America, with a man who, although trained as a metallurgist, had subsequently become a works reorganiser. He was called in by the owners of works—perhaps a foundry, a soap works, a gas works or any other organisation of a technical nature—if those owners were not satisfied with the output attained, and his task was to improve efficiency and output. He worked on a commission basis partly; he received a retaining fee for a certain time, and a percentage of the increased profits arising from his reorganisation. When asked if he could do this work single-handed, he had said he could not, but he had found that his training as a metallurgist, which had included a study of chemistry, physics and a number of allied subjects, had peculiarly fitted him for reorganisation work, whilst his inclination also was in that direction. When asked how he had obtained his experience, he had recalled the old adage "A rolling stone gathers no moss," and had said that as a young man he had never stayed at any one works for more than two years. The chairman suggested to young men, therefore, that they might consider seriously whether there was not a good deal of truth in that. A man might stay in a works for such a long period that, although holding a fairly responsible position, his suggestions became less readily followed out by the directors than had been the case when he had first joined them; he became "one of them," and perhaps had not exactly the same footing as when he had first joined them. If a young man could break away sometimes from that "loyalty," if one like to call it so, towards a firm because it had given him a start, and if he would take risks, there were splendid opportunities to acquire knowledge for the class of work to which the President had referred in his address, and the ability to reorganise a works if called upon to do so. There were very few in this country who could do it. With all due deference to the foundryman, if, after having been in one foundry for a very long time, he transferred to another, he was inclined to ask for the type of machine he had been accustomed to, although there might be others more efficient.

The question as to whether the works metallurgist should be an assistant to, or on an equality with, the foundry manager, or should be a member of the senior staff of the works, was very debatable. It was lamentable that, when a works had an efficient and well-qualified metallurgist, the works manager should be able to walk into the foundry and order the use of scrap for a particular job without any reference to the metallurgist, and cut down machining allowances because he wanted to economise in the shop, without regard to the problems arising in the foundry. A metallurgist who had not a real position in the works could not stand up against that sort of thing, and therefore was not really performing the true functions of a metallurgist.

Again, there was a great deal in the study of human nature. In a number of foundries and works the introduction of the metallurgist had been regarded as somewhat akin to the introduction of a policeman. The chairman emphasised, however, that the metallurgist did not enter a works with the idea that he was a policeman; his purpose was to assist as far as possible by communicating scientific facts to those with whom he worked, and to give them knowledge of the underlying principles. Even the workmen, when they saw the metallurgist looking at the work, sometimes felt that he had come to criticise. No one, said the chairman, had a greater admiration than he had for the craftsmanship of the foundryman, but he had known, when looking at the work in the foundry, that the men were wondering what he was going to say about it, and that they were not expecting any praise. In probably 75 per cent. of cases, however, he could have given the men very lavish praise for their work. The problems they had to contend with in a foundry proved them to be excellent craftsmen. When in the United States, he had visited quite a number of foundries, and in each he had found a Britisher in charge; such was the excellence of the British craftsman. At some of these American foundries he had asked why Britishers were in charge. The works managers had replied that if a man went from this country to America, he was usually a fairly good craftsman and was looking for something better than he had had in his own country; otherwise he would not have gone to America. They had said that they gave a man more money than he received in his own country; he was loyal and put forward his best efforts, and he usually stayed. An American worker, however, would perhaps stay for twelve months and then go to another works—perhaps a soap works, sugar factory, or anything. The Britisher in America, therefore, was recognised as being a good craftsman.

Finally, with regard to appliances used in foundries, the chairman said it was again lamentable that some works managers, having very little knowledge of the foundry, would visit another foundry, see a particular machine in operation there, and then order one for themselves without consulting the foundry foreman, who would have to be responsible for its working. One could not expect that under such circumstances the introduction of a machine would be welcomed with open arms. He personally, however, had seen instances of that.

A Vote of Thanks to the Branch-President.

Mr. W. B. Lake (Past-President of the Branch and Hon. Treasurer of the Institute), proposing a vote of thanks to the Branch-President for his address, complimented him upon the immense amount of industry and thought he had put into it. He admired particularly the concluding sentences, in which the Branch-President had addressed the world in general; the sentiments therein, very admirably expressed, were sentiments with which all agreed.

It was not the custom, of course, to criticise a Presidential Address, although this address had been to a large extent a criticism, though a benevolent criticism, of the management of foundries in general. If he could not crticise the Presidential Address, however, he could at least comment upon the remarks of the chairman, who had spoken of a foundry world of existence of which he (Mr. Lake) was not aware, and of conditions which obtained in very few foundries in this country having any pretence at management. For instance, he could not imagine any works manager ordering moulding machines without consulting the foundry manager or foreman. Again, the chemist had been referred to in terms which revealed conditions which were incomprehensible to him. In the foundries with which he had been conversant—and he had had the privilege of seeing the internal working of quite a number—the chemist had always been subordinate to the foundry manager, from whom the former took instructions, and in 99 cases out of 100 the chemist had worked hand-in-hand with the foundry manager. On the other hand, no foundry manager would ever dream of fixing, without consultation with his chemist, the composition of the metal to be used.

Continuing, Mr. Lake said he believed there were two reasons for the statement made by Mr. E. J. Fox—and which had inspired the presidential address—to the effect that better technical advice and experience could be obtained from abroad than from this country. One was that for many years the foundry industry in this country had enjoyed a large measure of prosperity, which had lasted longer than was good for the industry, and that in consequence the management of foundries was handed down from father to son, irrespective of whether the son possessed the necessary ability. But that did not matter in those days, because the foundries were carried on in accordance with the old traditions; the old conditions were good enough to enable a good profit to be made, and consequently there was no need to worry. Then, when competition had arisen from other countries, where greater use was made of science and more energy and skill was applied to management, that competition was felt here very severely.

The second reason—and a still more important one—was that other countries, owing to their systems of protection, could produce in much larger quantities than ourselves, and were able to employ scientific men to assist them to improve the quality and quantity of their productions to a much larger extent than it was possible to employ them here, owing to our smaller production and consumption.

Those were two basic reasons why it was true that more experience was to be gained abroad than here. He emphasised, however, that we had realised our position, and that on all hands steps were being taken to remedy the defect; we were taking the fullest advantage of all the experience we could get, and he had every hope that in the course of a few years the reproach would no longer apply.

Finally, he expressed appreciation of the President's address, and thanked him most heartily for it.

Mr. F. Blackwell, seconding the vote of thanks, expressed gratitude to the Branch-President for having delivered an address which was most practical and helpful. One would hardly have expected, he added, that a gentleman who was not in control of a large manufacturing business would have been able to have given such detailed information.

Discussing conditions in the foundry industry, Mr. Blackwell expressed the view that environment had had in the past a tremendous influence upon foundry work. The workers in the foundry had been accustomed to a dirty job, often in a filthy building, and in many cases, though not all, of course, their intelligence was about on a level with their environment. He could see no reason why, in the future, foundry workers should not have the advantage of conditions more like those prevailing in the tool room, where there was beautiful machinery and tools, and where the men took a pride in themselves and were equipped with good overalls. There the atmosphere was conducive to uplift, whereas the foundry workers had never been encouraged to raise their status; that had been a very great fault in the foundry industry in the past. The foundry workers, however, were in no way to

* Foundry Trade Journal, October 6, 1932, page 201.

blame. Perhaps some employers in the past had inherited from their fathers buildings containing moulding sands and cupolas, and had carried on. To-day, however, some firms have built splendid foundries, with high roofs, good ventilation and splendid gangways; they are kept whitewashed and clean, and the conditions are very different from those which obtained in foundries in the past.

There appeared to be no standard for costing in the foundry trade of this country. Both America and Germany had something to teach the British foundry industry by the methods they had adopted for standardisation of costing so that no foundry owner would sell at less than cost.

Mr. Blackwell agreed with Mr. Lake concerning the buying of machines for use in the foundry. A works manager who would buy a moulding or other machine without consulting the manager or foreman of the department in which it was to be used, or even without taking the departmental manager or foreman to see the machine demonstrated, would be a perfect fool. If that were done at all, it could only be done in the most conservative works.

Discussing mechanisation and the views that were sometimes held with regard to it, he recalled an occasion on which he had visited a Continental works where a continuous-melting plant was in operation. The only remark made by one of the gentlemen who had visited the works was that the process represented nothing but slavery. That, however, was a very insular remark. There were, perhaps, many foundries in which complete mechanisation, including the installation of sand-recovery plant and conveyors, was not necessary, owing to the nature of the work, but it was debatable whether, by the installation of a small new plant, they would not be able to increase production and turnover by getting into the market under better conditions than previously. That was a point which only the individual foundries could decide upon. Since he had visited America, in 1926, he had often thought that one of the reasons why Britain could not mechanise to the extent that foundries in foreign countries had was that we had so many foundries making similar articles, and none of them could afford to mechanise. If they could amalgamate, they could afford to instal plant which would enable them to compete with foreign countries. It had to be admitted, of course, that mechanisation of moulding largely did away with craftsmanship; an intelligent man could produce moulds with a machine after a fortnight's training, but no one could call him a craftsman. If the necessities of the times compelled employers to change their practice, something had to be sacrificed, and in this case it was craftsmanship. There were many things in a foundry, however, which could not be done mechanically, and where craftsmanship must be applied. Again, industrial development led to the extension of craftsmanship. For example, the men who made the horse-drawn tramcars in the past were craftsmen, but those who made the electric tramcars of later years were far greater craftsmen. Whilst mechanisation would displace some workers, it would lead to the employment of a greater number. At his works mechanisation had been introduced wherever possible, and the number of men employed had increased from 700 to 1,500, so that mechanisation had justified itself from the employment point of view. Until a year or two ago two men had been employed carting sand back to the sand shop in wheelbarrows. He had bought a petrol-driven truck, however, and had made a 1-ton hopper, with the result that one man, using the truck, could move as much sand as had been moved by the two men with wheelbarrows previously, and in addition he moved about 40 scrap bogies per day from the moulding floor to the cupola lift; previously, four men had been engaged on this latter task, and had been assisted during part of the day by the men who moved the hot metal about. The foundry manager had been so pleased with the results obtained when the truck was introduced that he had asked for another—and had got it.

Finally, Mr. Blackwell congratulated the London Branch upon its President, and upon the very interesting programme arranged for the current session.

The Chairman, commenting on Mr. Blackwell's remarks on costing, said that the Institute's Technical Committee had a sub-committee dealing with foundry costing; he felt sure that if Mr. Blackwell said that he would like to be co-opted to that sub-committee he would be very welcome.

The vote of thanks to the Branch-President was then put to the meeting and carried with acclamation.

The Branch-President, in a brief response, said he considered it a bad custom that Presidents should not be criticised; a President should be criticised as much as the skipper on the bridge of a ship.

He expressed the hope that the coming session would be both happy and instructive, and expressed gratitude to Mr. Lockwood, the hon. secretary of the Branch, for having arranged to hold the meetings at Charing Cross Hotel, because a bright meeting room attracted good attendances.

A Vote of Thanks to Mr. Lambert.

The Branch-President then formally occupied the chair, and on the motion of Mr. G. C. Pierce (Past Branch-President), seconded by Mr. A. R. Bartlett (Past Branch-President), a hearty vote of thanks was accorded Mr. Lambert for having presided during the early part of the proceedings. Both the mover and the seconder expressed regret that the Presidential address was not open to discussion, because it contained many points which were worth discussing.

DISCUSSION.

It having been ruled by the Branch-President that the address was open to discussion if desired,

Mr. G. C. Pierce said he welcomed the address because it represented an honest endeavour to get to the rock bottom of the problem dealt with. He suggested that the present position of the foundry industry was due more to international economics than the fault of foundry managements. Two prominent features in connection with economics was that, on the one hand, the powers that be were making a very strong effort to raise wholesale prices, whereas, on the other hand, the same powers were making every effort to reduce the purchasing power of the people in the various countries. He could not see how those two features could be reconciled. Perhaps over-production in the past was the basic cause of our troubles. When we overcame that, whether by shortening working hours or by any other means, probably we should revert to conditions such as had obtained in the past, when there was money to spend on tools, and so on. During the past 15 or 20 years there had been an immense change in the outlook of those responsible for running foundries, and he had no doubt that if circumstances were different to-day those responsible for foundries would be as willing as anybody to take every step possible to ensure progress.

With regard to amalgamation and mechanisation, he pointed out that there is a large number of small jobbing foundries in this country, and he could not see how it would be possible to amalgamate them, having regard to the variations in the classes of work they were doing. Commenting on the references made to the effect of mechanisation on craftsmanship, he referred to a case in which a first-class craftsman, who had been foreman in a very good foundry, had since worked in a mechanised foundry in the capacity of a labourer, and was getting more money than if he had been following his craft.

Mr. A. R. Bartlett emphasised the importance of co-operation and co-ordination. Mechanisation was more or less an essential in foundries where it could be applied, but how many foundries applied it? The "prime mover" in the foundry was the sand, but the human element was depended upon in the mixing of it. One of the first thoughts of those responsible for foundry management should be to obtain a mechanical means of mixing sands and adding the correct proportions of water. It was often said that a casting was full of blow-holes—although it was difficult to define a blow-hole—but much of the trouble could be overcome if mechanical means were adopted for mixing sands to the correct consistency for moulding.

The co-operative or team spirit was more necessary in a foundry, perhaps, than anywhere else, but that spirit was not always apparent. Sometimes the people in authority lacked foundry knowledge, and that was why the foundry was lagging behind other shops in engineering works. It was said sometimes that there was no money available with which to provide foundry tools, but it was noticeable that money was available to buy tools for other shops. Commenting on Mr. Lambert's remarks concerning the position of the metallurgist, he said his experience at his own works was that the metallurgist there was always very willing to co-operate. He loved the foundry, and even apologised for coming into it so often; but he was always welcome, and took as much notice of Mr. Bartlett's daily test—which was an adaptation of the Keeps test, for keeping the metals constant—as of the analyses carried out in the laboratory. As a result, there was a real spirit of co-operation and helpfulness.

The meeting then closed.

Catalogue Received.

Aluminium. — The British Aluminium Company, Limited, of Adelaide House, King William Street, London, E.C.4, have sent us another picture book, carrying the caption "Industrial Problems Lightened with Aluminium." It opens with a short crisp message, which in twenty lines lays bare the versatility of aluminium. Then follow 15 pages of excellent sepia illustrations, which are not improved by having a narrow white band separating them from the sepia margin. We make an exception of illustration No. 7, but still we think that a white border or even completely solid sepia would improve this brochure. We believe this is the first time we have ever made a suggestion for the improvement of the British Aluminium Company's publicity matter, which we always regard as setting the standard of excellence for the whole of the metallurgical industries.

Publication Received.

Tidsskrift for Kjemi og Bergvesen (Chemistry and Mining Engineering Review—Oslo, Norway—for September). Subscription: 12 kr. per annum.

This issue is a special one, and is devoted in the main to an illustrated history of the Mining School, which this year celebrates its 175th anniversary, and a number of the older mining enterprises of Norway. It is printed on art paper and excellently illustrated. We would like to add our congratulations to the Mining School on its long and useful career.

Glycerine used alone or with water can be used as a quenching medium; by mixing with water the cooling rate can be varied. It is fairly costly, but does not readily decompose and presents little fire hazard.

"Guaranteed" Castings.

A DEBATABLE SALES POINT.

The first meeting of the session was held at the Neville Hall, Newcastle-upon-Tyne, on September 24, when Mr. W. Scott, the newly-elected Branch-President, delivered his Presidential Address.

Presidential Address.

Mr. Scott, after thanking the members for his selection, said it was perhaps appropriate at such a time not only to review the past activities and the future aims of the Branch, but to criticise themselves without fear or favour, in relation to the industry which was the dominant factor responsible for the existence of the Institute. Only by this means could one contribute to the welfare of the foundry industry in general and the trade in their particular area, to say nothing of their own interest and happiness. Owing to Tyneside being in the throes of the greatest industrial depression known, much of the past year's work was done under great difficulty, but nevertheless they could be justly proud of the satisfaction they gave in the staging of the Annual Conference of the Institute in their city. One heard many kindly expressions from the visitors as to their adaptability in the lean times through which the marine-engineering industry was passing, but perhaps this was to some extent the result of a general view of Tyne activities.

Could one confidently say that foundrymen were adapting themselves to the changing influences and requirements of the modern foundry? He thought not, and it was just that thought and aim which had brought the Institute of British Foundrymen into being. To-day they were aware of the new outlook in the foundry—the mechanisation which economical considerations had rendered necessary—the new standards of dimensional tolerances, general finish of castings, and, last but not least, the remarkable change in both quality and variety of cast irons now demanded and produced, which had almost demolished the distinctions between cast iron and steel.

One saw the old valuation of cast iron as merely a "mass" material, replaced by one commanding high respect, the old "10 tons per sq. in." raised to "25 tons per sq. in.," the old "all-in-one" structure multiplied into half-a-dozen or more forms of iron. Heat-treatment of cast iron was freely discussed and practised, yielding strengths of over 40 tons per sq. in. What did this new viewpoint and attainment mean to them? It meant that to keep pace with their competitors and to preserve the high-water mark of attainment, for which Tyneside engineering had been rightly famed, they must keep in touch with modern developments, and by free discussion of their own pioneer work, help in such furtherance of their art, as to become a respected and worthy section of the Institute to which they were attached.

With this object in view, their esteemed secretary had arranged an excellent programme for the forthcoming session, but it was for each of them to make the most use of the Institute by regular attendance and discussion at lectures, which represented much time, energy and thought on the part of those who so kindly undertook to come before them and give them the benefit of their special knowledge.

The predominant thought in the whole of their minds at the present time was, of course, this acute depression through which they were passing. Never in the experience of any of them had they had such a scarcity of productive work as at the present time. This, of course, applies chiefly to their own district, as other parts of the country had more or less alternative works policy. On Tyneside they appeared to have principally one business, that was shipbuilding, and when this was done, the engineering industry was practically at a standstill.

The present crisis was actually part of their development. Nothing on earth had power to bring things back exactly as they were 10 or 12 years ago. During this period tastes had largely changed. Much of the world's work, such as bridgebuilding, road making and shipbuilding had been made in abundance and would therefore last for many, many years without replacement. They had therefore to get down to new conditions, and if they were to survive it would be by making totally different productions from those they were accustomed to. This period of slackness, therefore, in the natural order of things, gave one time to reconstruct and plan for new lines of manufacture.

Every executive in the foundry world to-day, instead of having an easy time during the slackness, should be working much harder than he did 10 years ago. This was because he should be fighting with something new. Work which the tradesmen were accustomed to do was very easy to control, but with new methods, and when new products were being made, research work must be done to keep things on the straight path. It was, therefore, a very difficult time.

People were wont to say that Tyneside, as a manufacturing district, was finished, and that all the industries were moving South. Evidence of this was given in the statistics, which show so many thousands more people living in the South or in the neighbourhood of London, so many more factories opening, and it did make one think there must be something in it. Moreover, there was something in it, and there would be something more in it if they did not look to their laurels. The whole of Northumberland and Durham was too rich in basic materials for them to be entirely lost.

It took three things to produce new business—the first necessity was raw materials, the second was man and brain power, and the third was demand. They in that area were the last people to admit the shortage of man and brain power, and having raw materials, then, the only thing necessary to complete the circle was the demand. Demand was only another word for brain power, for where there were brains, the cause which produces the effect called demand was soon found. For this effort there was no time like the immediate present. Raw materials were as cheap as they ever would be. Labour was cheap, and the people as a whole were in that state of mind which readily accepted anything new. They had become accustomed in the last few years to hearing about marvellous new things; they would readily accept and give trials to anything that had a fair promise of utility. In the same way that "Charity begins at home," so did the need for new inventions begin at home. Until every home was provided with heat which was dirtless, foods and drinks which were cold, proper accommodation for bathing, efficient and reliable transport of its own, and other essentials, then the desire for fresh inventions would never cease.

In the workshops, need for new inventions would never be satisfied, and the field of endeavour was a much wider one. In spite of the general shortage of money, the people as a body were better fed, better clothed and better educated than they ever were, and it was time there were some results from this better education.

One thing worthy of stress was the lack of interest shown by founders generally in this district in the local Branch. It was really appalling to compare the total number of skilled foundry workers in this area with the number which attend the meetings. It would appear that, with very few exceptions, the whole of the foundry executives have a 7.30 to 5 o'clock mind, *i.e.*, as soon as their own particular buzzer had blown, all thoughts of foundry work were cast on one side. This was not the way to progress, as no one man could learn sufficient from his own experience—life was too short for this. It would be a better omen for the future if in bad times membership increased rather than decreased.

The Relationship between the Foundry and its Customers.

As far back as he could remember, and as far back as he was able to read reports, the foundry side of engineering had always been the "black sheep of the family." What was the cause of this? Founders raved and stormed about rejected work, saying on many occasions that the casting would do the job. They blamed the engineers responsible for non-acceptance. The cause of this annoyance on both sides was the fact that the engineer was losing money by machining a casting which might be of little use. In a few cases it was because of the delay, but probably the major part of this annoyance was ascribable to the money he was wasting on machining. The time was fast approaching when all work would have to be guaranteed. This would eliminate this annoyance and would have to be based on a complete refund of any money wasted on machining. This, on first thoughts, made one shudder, but careful analysis of past failures had led him to believe that it was not an impossibility. Generally speaking, a 10 per cent. increase in the cost of all castings would more than reimburse a founder for his total moneys paid out for wasted machining time.

This would have two great benefits. First of all it would keep the customers—the engineers—in a happier state of mind. This would be worth some few hundreds a year to the poor foundryman. In the second place, it would put up the price of castings all round, and therefore put foundry work on a higher plane than it is at present. Probably it was due to the cheapness of their products that they used to be the "Cinderella" of industries.

Second thoughts on this subject were that castings would be rejected right and left because of the return of the machining costs. Personally, he thought the exact opposite would take place. Whereas now with a casting, on the first small defect showing itself, the engineer was suspicious of what might follow and immediately condemned it. If he were assured that a complete return of his expenditure would be made, he would go further with the machining and would finally prove its merit. The number of castings thus saved would more than balance itself up in the course of 12 months.

One indirect result of this in the foundry would be closer inspection before delivery. This would mean more internal rejections and less external. In a few months the engineers would really be their friends. They would realise that they were manufacturing something which was of vital importance in their industry, and the foundry world would rank equal in importance with the engineers.

He anticipated hearing that this mode of procedure would not be possible. He assumed then, however, that there was one foundry to-day that worked exactly on those lines, and in spite of playing a lone hand in this game, they were meeting competition quite well.

Analysing one of their own local products, *i.e.*, the marine Diesel engine, this could easily contain 60 per cent. of iron castings. An engine of 2,500 h.p. would probably have between 200 and 250 tons of castings in its make-up. If the price went up 10 per cent. this would mean an approximate price extra on the whole engine of £450 to £500. What was this £500 in com-

parison with the final cost of the engine, which may be, say, £40,000 to £50,000 in value? He felt sure any engineer building Diesel engines would willingly pay £500 for guaranteed castings. It would also have the effect of eliminating unfair competition.

Education of Allied Trades.

Up to the present founding as a whole had suffered greatly from the inefficiency of designers. Very few draughtsman had sufficient knowledge of foundry technique to design even a balance-weight correctly. When it came to a really imposing, complicated casting, the results were often appalling. He realised that it was a simple matter to criticise this state of affairs, but he wished to make this constructive criticism, and suggest the following two measures to combat the evil for future generations of foundrymen.

First, that all youths intended for the designing office, when of age, should spend three years in the foundry—the first year in the pattern shop, the second in the foundry and the third in the laboratory and melting sections. This would be far more beneficial than the customary 2½ years in the machine shops, where castings were merely trimmed up and erected.

The second measure was one calculated to bring in quicker results though not so good in effect. That was to enlist the interest of all draughtsmen in the district in their meetings. As an ex-draughtsman he could speak with feeling. He knew that this time would be well spent and the benefits of founding would be immeasurable.

Modern machining methods were such that much study for machining was unnecessary, the operations having become purely mechanical, and it therefore followed that apart from the actual theoretical design of the machine or engine, that was to ensure that it would do its work correctly, the next most important thing was the manufacture of the article itself. One was safe in saying that there was more science and interest in the foundry world to-day than in anything else. Owing to higher speeds and smaller overall sizes of engines, the castings had become more complicated in design, making it more difficult actually to produce from a moulding point of view, and more difficult to make sound from a metallurgical point of view. If foundrymen who realised all this did not advertise the fact, then they would be labouring for a great many years under great disadvantages. Designs would leave the designing office of increasing complication and almost impossible to manufacture satisfactorily.

Co-operation of designer and foundryman at the birth of a casting, that was on paper, would solve many of these troubles before they actually existed. During the last few weeks, in reading technical Papers, he had been very interested in the number of proprietary alloys, which were now manufactured. In reading through a list of over 200 of these alloys, he was struck by the fact that not one was made on Tyneside. Why was this? They were doing some of the world's best work, and one felt that they ought to be making some of these special alloys which seemed so necessary in modern engineering. One of them in particular, although not a new one, was just coming to the fore front, and being used for more things every month. That is a magnesium alloy called "Elektron." It may be of general interest to a few present to mention some of its characteristics. It was an alloy which had come into prominence chiefly on account of its lightness in weight. An intelligent application of Elektron in place of aluminium showed a saving of 40 per cent. on the total weight. Against cast iron, of course, this would show a saving of about 80 per cent. on the same strengths. The melting point of this material was about 640 deg. C., and certain safeguards had to be applied to prevent the total loss of the metal in melting. Molten magnesium on exposure to the atmosphere rapidly forms oxides and nitrides, which having almost the same specific gravity as metal itself, became disseminated through the bath and contaminated the metal. The real progress of the production of sound castings was almost impossible until this initial difficulty was overcome.

A flux had now been evolved, which very satisfactorily solves the problem of melting magnesium alloys. This flux is a very viscous one and it is not readily dissociated at high temperatures. The molten surface is kept covered with a skin until the whole charge is melted, after which the temperature is raised to ensure the complete fusion of the flux.

Some few weeks ago he had the pleasure of visiting a foundry which had started on this type of casting, and they were producing about 1 ton per week. This does not sound much, but when one considered that a crank case 5 ft. by 2 ft. by 18 in. could be picked up easily with one hand, one could see that a ton of this goes a long way. Its machining properties were perhaps the most startling feature, as this was machined at something like the speed of ordinary white pine. In the fettling shop, the men picked up a casting with the dimensions cited, ran it round with an ordinary high-speed band saw, cutting off all flush, gates and risers just like cutting firewood.

Certain difficulties exist in the moulding sand for this metal, and, although a dry mould was supposed to be the best, surface oxidation still takes place. From the failure of this form of moulding, the opinion was formed that it would be necessary to surround each grain of moulding sand in the neighbourhood of the metal, with a complete pellicle of some substance, itself inert to molten magnesium, preferably with a strong affinity to oxygen, and of such a nature that, whilst freely penetrating all the pores of the mould, would not readily escape, and so leave the sand surface layers unprotected.

The desired substance was found in sulphur, which was mixed in small proportions with boric acid, with ordinary moulding sand. This, of course, was a patented process, but the castings which he saw in this foundry were thoroughly sound and clean castings in every way. He mentioned these few notes on this alloy just to create some interest in things other than cast iron and steel, and the standard branches of non-ferrous, such as aluminium and phosphor bronze. He mentioned it purely to emphasise his previous statement that on Tyneside they were somewhat inclined to adhere to one subject. If there was no work to do in this particular line of business, then they are in a quandary. Of recent years, they had even lost their hold on the steel-casting market, and he doubted whether there was a steel foundry operating in this district.

DISCUSSION.

Mr. C. Gresty expressed his appreciation of Mr. Scott's address, but thought he was unduly pessimistic about the future of the industry. With regard to his suggestion of the foundry guarantee covering machine-shop costs, if such a scheme were possible a rise in prices would be essential, but how were they going to bring about such a thing? He was afraid that the buyer would want the guarantee without the increased price. In certain cases a plan of this nature might work reasonably well, but there were many cases where the cost of machining was considerably more than the value of the casting itself.

Mr. Scott reminded Mr. Gresty that the suggested increase of 10 per cent. was to be put on all castings. Five per cent. of castings might be rejected, but the 10 per cent. extra on the other 95 per cent. would cover the machine-shop costs on those rejected.

Mr. Gresty said that while that might be so, he did not see how they were to get buyers who would agree to 10 per cent. extra on *all* castings. How about those which were not machined at all or on which the amount of machining was very small in proportion to the value of the casting? Also one could see that there would be tremendous discussions as to the cause of failure in doubtful cases. Frequently difficulties were overcome by changing the design of a casting, and sometimes patterns were at fault. He thought there would be an increasing tendency to throw the blame for all faults on the foundry.

Mr. Scott said that in his opinion, once the foundry had accepted a design and quoted a price for doing the work, that was an indication that they guaranteed to carry it out. In particular cases, one might be able to waive the question of the guarantee. His idea was that if such a guarantee scheme could be carried out the foundry would be getting more money than it was to-day. Referring to Mr. Gresty's remarks about patterns, Mr. Scott said that the people responsible for the faulty patterns would be responsible for the faulty work resulting from them.

Mr. J. D. Carmichael also expressed his thanks to Mr. Scott for his address. He said that he entirely agreed with Mr. Gresty on the score that they would be unable satisfactorily to apply Mr. Scott's scheme with regard to guarantees. With reference to Mr. Scott's remarks concerning collaboration with draughtsmen, he suggested that Mr. Scott and the secretary should get into definite touch with their Association and arrange some joint meetings, which would be very valuable as a starting point.

Mr. Dawson said that he thought that much of the difficulty which would be found in the question of guaranteeing castings would come about owing to the different classes of work made. For example, the buyers of small, straightforward castings would never stand their share of the 10 per cent. increase. If they tried to have two prices, one with and one without the guarantee, 10 per cent. would not cover the extra risk on certain types of castings. They had to think of the man who wanted small repetition castings; he would not pay any extra. The best guarantee a foundry could have for that man would be to break a casting occasionally to let him see what it looked like. Certain castings were now made giving 24 tons per sq. in. tensile test instead of the old 10 tons, but they were not getting a greatly enhanced price for them. In spite of castings, such as magnesium castings, which were much lighter, they were not being paid any more relatively. In fact, the lighter the job, the worse off the foundry was, because it entailed so much core making, which was an expensive matter. He suggested that they should have a price based on tensile strength, more money for every ton per square inch increment. Referring to educational matters, he had heard of a college in Newcastle where very good instruction could be obtained, and out of that area only three applicants had been enrolled for lectures on non-ferrous metallurgy. In other industries, such as paints and varnishes, oils, fats and so on, there were just two or three applicants. Mr. Scott had mentioned that in his opinion they were a little behind the times in comparison with other parts of the country. Would it not be possible to have a discussion, say once a month, on lectures given before other Branches of the Institute and current work in general in other parts of the country.

Mr. Scott said that the question of the tensile strength of castings hinged on the question of the draughtsmen. The draughtsmen of to-day still based their calculations on the old 10 and 12 tons per sq. in. With regard to Mr. Dawson's suggestion about a discussion on work being done in other parts, he would like to propose that at the end of every lecture after the discussion was closed, they should have a

(*Concluded on page* 225.)

A New Steel-Making Process.

BELGIAN FOUNDRY USES ROTARY PULVERISED-FUEL PLANT.

By Vincent C. Faulkner.

Whenever a real development within the foundry industry is recorded, there is always some person who comes forward and states that this was done years ago in so and so's foundry. Thus when we state that last week we paid a visit to the Mons Foundry Company in Belgium and assured ourselves that excellent small steel castings were being regularly turned out in a pulverised-fuel-fired rotary furnace, we are prepared to learn that this has been done previously and elsewhere. Thus, it must be acknowledged quite frankly that our columns do record[1] the fact that steel for castings has been made in this type of furnace previously. The case of the Mons foundry, however, is totally different.

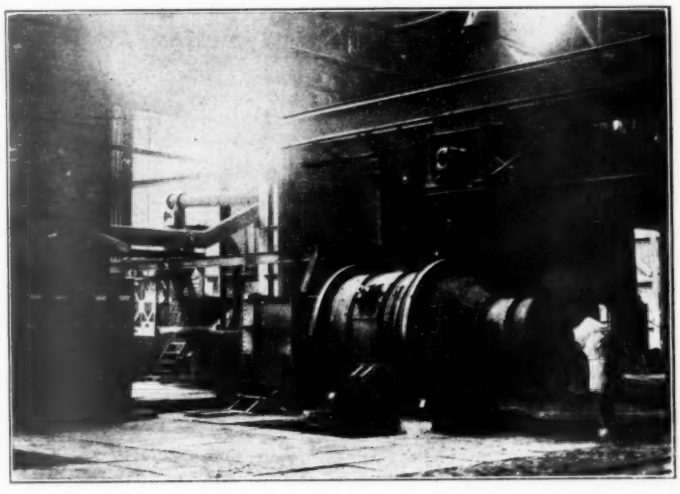

Fig. 1.—A Rotary Pulverised-fuel-fired Furnace engaged practically exclusively on Steel manufactured at the Mons Steel Foundry.

Here is a well-known steel foundry, making no iron castings at all previously, utilising the baby Bessemer process, having the courage to instal a pair of 2-ton Sesci furnaces of French manufacture with the definite object of cheapening the costs of production, whilst maintaining quality. That is a very different proposition from an iron foundry which, already possessing a pulverised-fuel-fired rotary furnace, decides to make one or more experimental casts of steel. Thus we insist that the plant at Mons, if the success now showing is maintained, has opened up a new era in steel-foundry practice.

We do not propose to detail the construction of the plant as in a recent issue[2] our colleague, Mr. Percy Fox Allin, has described in detail a plant of similar character installed in the foundry of the National Gas Engine Company, whilst we ourselves described the original Sesci[3] at the Close Works, Gateshead. Moreover, Scott & Dawson[4] have also given excellent descriptions of the actual operating details of such plants.

We feel that our remarks will be more to the point if confined to probing just what this new development means to the steel foundry industry by making comparisons with established methods of melting.

Capital Costs.

On this score, as far as we can see, the cost of installation of rotary plants would be much the same as a baby Bessemer plant, but as the yield would be halved, the allowance for depreciation would have to be doubled. Compared with the electric furnace, the installation cost would be much the same, whilst the yield would be of like character.

Raw Materials.

Compared with the converter, a great saving is at once apparent, as there is a complete elimination of hematite pig-iron. But a factor of equal importance is the considerable metallic losses normally associated with the converter process. The charge we saw run through at Mons was a mixture of runner and riser scrap—fishplates, spring steel, turnings and 6 per cent. of converter spillings. Compared with the electric furnace, there is no difference on this score. When it comes to the cost of fuel, the comparison becomes more interesting so far as the electric furnace is concerned. Herein there is not only a bill for, say, 800 units per ton to meet, but also the cost of the electrodes. Probably 10 lbs. per ton of electrodes will cost as much as the fuel for the rotary furnace under existing conditions. Of course, most British electrode furnaces work basic, and may be able to use still cheaper raw materials than the rotary furnace, though in point of fact they do not. What the electric furnace does is to produce steel of lower sulphur and phosphorus content from precisely the same raw materials. We, personally, would very much like to see some experiments made with basic-lined rotary furnaces. With lowered metallic losses, and absence of contact with coke, the rotary furnace should be producing steel of slightly less sulphur and phosphorus content than converter metal.

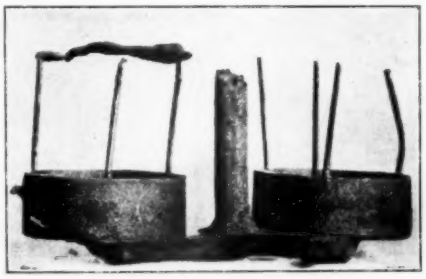

Fig. 2.—Shows how, after filling the Mould and Whistlers, the Steel was sufficiently hot to form a Spill.

Labour.

The labour normally employed on electric and converter plants is well known. So far as the new process is concerned labour for assembling the charge and putting it into the furnace is comparable with an electric furnace installed at ground level, except that this Sesci furnace is charged semi-mechanically by utilising a mono-rail-suspended large-sized, rotatable scoop which, coupled with a certain modicum of rotation during charging, makes the work a little easier and quicker. Once the furnace is charged, one operator can easily take charge of two furnaces, as there are no electrodes to regulate, which, even where automatic regulation is in vogue, usually requires hand operation for a short while. On the other hand, for Sesci the coal has to be ground, but this feature is becoming more and more automatic as the plants become developed.

Refractories.

This is still exercising the minds of all connected with this new industry, and a good deal of loose talk is encountered. The position is now quite clear, and, so far as steel manufacture is concerned, 40 casts are made and the lining is renewed. Now, we have had no personal experience of oil-fired converters, and we are relying on Mr. Paul Fassotte's statement that this figure of 40 heats is approximately the same for both processes on similar-sized vessels. The great difference between rotary furnaces and all others is this: In the converter the cupola and vessel are lined and afterwards they are patched daily. In the electric furnace the lining is made up from a number of refractory materials of varying nature and cost and after 120 heats a new roof is bricked and after every heat the bottom, banks and tapping spout are repaired. In the rotary furnace there is the one job of making a new lining. Thus there is a more or less frequent big job, with a complete elimination of the day-to-day labour, time and material absorbing work of patching. Thus any calculation of refractory costs reveals without question an unimpeachable figure for rotary furnaces as against a good deal of approximation in the other cases. As time passes, the cost of refractories is becoming much less a bear point in favour of the newer processes.

Quality.

For a visitor to a steel foundry, the following factors of quality can be noted:— (1) "deadness" and fluidity of the metal, and (2) the surface of the unfettled castings and (3) the general mechanical properties of material. On the score of "deadness," we saw two heats cast by means of shanking for a reservoir ladle and in no case did a casting "rise." The surface of the castings was excellent. So far as fluidity is concerned we picked up and had photographed a pair of disc castings cast as a composite whole which showed the metal to have spilt over the top of the mould after having passed through the whistlers. This is shown in Fig. 2. The general mechanical properties as revealed by an absence of tears and shop bending tests were entirely satisfactory.

What the Process Discloses.

To summarise the position as revealed at Mons, the following can be stated:—

(1) For the first time in history a rotary pulverised-fuel-fired furnace was regularly em-

(*Concluded on page* 228.)

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1 Dr. P. Bardenheuer, Foundry Trade Journal, April 23, 1931, pages 287-290.

2 P. A. Fox-Allin. Foundry Trade Journal, September 8, 1932, page 135.

3 Sesci Furnace at Close Works, Gateshead, Foundry Trade Journal, February 19, 1931, page 137.

4 W. Scott and S. E. Dawson, Foundry Trade Journal, June 2, 1932, pages 335-338.

Scottish Foundry Industry.

Mr. H. D. Campbell's Views.

The opening meeting of the session was held in the Royal Technical College, Glasgow, on October 1. Mr. N. McManus, M.B.E., the retiring President occupied the chair.

The Chairman in opening the proceedings welcomed the members to the beginning of another session's work and expressed the hope that the Papers and Lectures arranged would prove interesting and beneficial to them all. That meeting marked the passing of another milestone in the history of the Scottish branch and also the end of his presidency. He re-expressed his thanks for the honour they had accorded to him. It had been an experience which he had found extremely interesting and he would cherish the memory of his period of office all his life. He then introduced to them his successor, Mr. H. D. Campbell. Mr. Campbell's abilities and interests in the work of the Institute were well known. In asking him to take the chair he could only wish a successful and interesting year of office, and to bespeak for him the same strong support and assistance that he himself had received.

Presidential Address.

Mr. H. D. Campbell, on taking the chair said that he wished to thank Mr. McManus for his very kind remarks and the members for the enthusiastic welcome which they had given him. He had been diffident in accepting office but with the assistance of all the members of the Branch would endeavour to uphold the traditions of the position. Mr. Campbell then delivered his address in the course of which he said:—

Mr. McManus and gentlemen: Not being an actual experienced moulder, but an engineer who drifted into a foundry, it was with considerable diffidence and trepidation that he undertook the duties of being their President, but having been more years in a foundry than any other sphere, he thought he could claim to have a fair working knowledge of the trials and tribulations that beset the foundryman. Not having been through the sand, he looked for their kind indulgence for such errors of omission or commission that he might make and promised on his part to do his best to uphold the dignity and forward the aims and objects of the Institute.

An interesting programme had been arranged for the ensuing session and both the Falkirk and the new Edinburgh sections had meetings of great interest to all foundrymen, and he hoped as many gentlemen of the Branch would attend some of those meetings which, while encouraging and helping them, would at the same time reap benefit themselves.

They met still under the shadow of the longest period of industrial depression ever known, and it was a most remarkable fact that their membership was practically holding its own even in such a time which showed that they are a virile body in discussing their problems, exchanging views, and, like the Athenians of old, ready to listen to any new thing, discuss it and, if they believed it good, to try it out.

The Position of the Foundry Trade.

At the moment trade is definitely bad, but not more so than any other associated trade, and better off than many, due to the diversity of the trades who use their products, and he put forward the theory that a certain amount of adversity would be for the good of those who are prepared to learn the lesson. During boom times many extravagances and laxities creep in. When adverse times come, one is compelled to consider ways and means, cupola control, sand control, lay-out, improvement of plant. All these points receive special attention at such times. The individual savings may be small, but in the mass they always help to raise the factor of efficiency. Self-complacency receives a shock, and, though the average man objects to being shaken out of his groove, still, for those who are prepared to learn the lesson, a certain amount of good will accrue.

When better times come along, as it is generally believed come they will, when the nations of the world have learned that they cannot be self-contained units selling everything and buying nothing, he thought there will still be great opportunities for our industry. They have to produce, not hot air nor rabbits out of hats, but something tangible. Good sound castings that will stand the test of machine shop and pressure pump, and up to the present, he thought they may claim to have done it fairly well. In the future they will do it even better.

Modern Requirements.

The foundry at the moment is under the most intense scrutiny of the metallurgist and the engineer. Laboratory samples, with specified properties are being produced, and it is the task of the foundryman to bring these experiments to a successful conclusion on the foundry floor and produce intricate castings true to type as and when required. This is no easy task. The use of furnaces such as the Brackelsberg or Sesci type, about which we are to hear something this session, will help as to regularity of mixture and temperature. But there are still many other problems, such as gates and runners, whether one can use greensand or drysand, section thicknesses related to the mixture used and the many details for the working of something special in a general shop. He had not mentioned the electric furnace as a rival to the cupola, for, as far as this country is concerned, its time is not yet opportune, but such furnaces as the Sesci and Brackelsberg do claim to rival the old and tried cupola, and no doubt we will all be interested to hear how it compares in costs when running casts up to and exceeding 75 tons per day and producing, say, 10, 15, or 20 tons per hour, to suit the work of the foundry.

Rationalisation.

We have heard a good deal about rationalisation as the cure for all our ills. In certain circumstances, as long as you can control it, it may be good, but one can also imagine it as a mighty Moloch devouring its victims. He believed that comparatively quite small units, when well managed by a keen intelligent staff associated with a good costing system, can do much to help matters. Unfortunately, the principle, or lack of principle, of making up on the swings what was lost on the roundabouts is too often in vogue, and if the other men's swing is your roundabout, and *vice versa*, matters can only become worse when competing for such small quantities of work as are going about in these times. Such a foundry is more human than a mighty corporation with mysterious heads, who issue edicts generally just, but sometimes unjust, who would mechanise everything and everybody which tends towards an inflexibility entirely absent from the smaller unit. Mechanisation, of course, is bound to proceed, but it is of itself creating problems. Mass production undoubtedly is contributing to our unemployed problem, and it limits the opportunities for the training of apprentices. Skilled moulders will always be required, for there is a great deal of work which can never be passed to the machine and semi-skilled hand, and even the highly-mechanised mass-production foundry will require trained moulders for their charge hands, etc., and a limited specialised training will not be in the best interests of the industry.

This matter will require now, and in the future, the serious consideration of every foundryman. Also, we as a body should bring before the boys and lads the claims of education. Our prize scheme brings us into closer touch with the education authority, and the interesting talk we had from Mr. Dunlop Anderson last session shows that they are keen to help us.

A New Technical School.

Mr. Anderson had informed him that the new Technical School in Shamrock Street will be ready in about a year or 15 months, and that he wishes to work in the closest co-operation with us, and that his particular desire is to make the classes of the greatest interest to the lads working in the sand and fit them to be better workmen or for minor executive posts. The classes were not to be too highbrow, but suitable for lads who had left school at, say, 14 or 15 years of age, the chief aim being to give the lads a sound knowledge of the whys and wherefores of the science of the foundry, or set them on the way for the higher classes of the Technical College. He appealed to everyone in contact with the apprentices, especially the foremen members, who can help most, to impress on them the advantages of these educational chances. The foundry of the future will demand an ever-increasing degree of skill and technical knowledge, and the foundryman must go forward and the same thought or more should be bestowed on the personnel as on the equipping of the foundry itself.

It is very difficult to touch an optimistic note in view of all the adverse conditions we have to face at the moment in this area. Empty shipyards and silent workshops, or in many cases only partially employed, and no sign of revival anywhere to be seen. The condition of our trade was even worse than a year ago; let us hope it is a case of the darkest hour preceding the dawn. That light and leading will be given to all who have it in their power to remove or help to remove the artificial barriers and restrictions which hamper the trade of the world, a world, curiously enough, suffering from a glut of good things which man, with his blundering, seems to be unable to distribute properly. We, as foundrymen, a basic trade, must therefore see to it that we are prepared and ready, mentally and materially, to seize the opportunity when it comes, and which I believe the future holds for us. The laws of nature operate in the same way on a foundry as on any other thing. They are hard and stern, and based upon the survival of the fittest. We must, therefore, be fit and ready, and our watchword "ever forward."

Vote of Thanks.

Mr. John Longden said it was not the practice to discuss the presidential address but he thought that they would all appreciate the general review which he had given and would do well to take note of the warning he had uttered not to be too pessimistic about the future of the industry and to use the present time of adversity as a stimulant to improvements in methods and technique. The address had given them a considerable amount of food for thought. He therefore asked them to express very heartily their thanks to the President for his address.

Mr. H. W. Winterton, who seconded, said the President had struck a note of optimism which was very welcome and which he personally sincerely hoped would prove correct. He had much pleasure in supporting the vote of thanks.

Mr. Campbell, in acknowledging, said it was very gratifying to him to learn that the optimistic feeling was appreciated by the meeting. He thanked them all. He then asked them to receive a Paper on "The Preparation and Handling of Sand by Mechanical Means in other than Mass-Production Foundries," by Mr. R.

(*Concluded on page* 225.)

Scale Removal by Acid Pickling.

By A. B. Winterbottom and J. P. Reed.

(*Concluded from page* 205.)

Discussion of Results.

The etching experiments and also the quantitative investigations seem to establish the fact that the mechanism of scale removal is the same in the case of dilute sulphuric and hydrochloric acids, and by inference in the case of any acid-which FeO is unstable is difficult to pickle, and the action in such cases must be different, probably involving partial solution of the magnetite or Fe_2O_3 at grain boundaries followed by reduction of ferric salts so produced by the metallic iron.

TABLE III.—*Times for Pickling Standard Material with H_2SO_4 Pickles at Various Temperatures and Concentrations.*

H_2SO_4. Grm. per litre.	25 deg. C.	35 deg. C.	50 deg. C.	60 deg. C.	80 deg. C.
	Min.	Min.	Min.	Min.	Min.
10	440	251	99	73	48
30	210	87	46	29	14.5
50	165	79	36	22.5	10
80	125	58	27	19	8

Volume of pickle liquor: 50 c.c.
Material: 1¼ in. of ⅝ in. × 16 S.W.G. conduit. Area scaled, 28.5 sq. cm.; thickness of scale, 0.015 mm.; weight of scale, average 0.27 grm., or 0.01 grm. per sq. cm.
Average acid consumption: 0.35 grm. of H_2SO_4.

TABLE IV.—*Times for Pickling Standard Material with HCl Pickles at Various Temperatures and Concentrations.*

HCl. Grm. per litre.	25 deg. C.	35 deg. C.	50 deg. C.	60 deg. C.	80 deg. C.
	Min.	Min.	Min.	Min.	Min.
10	255	86	48	37	27
30	45	25	13	9	5
50	33	18	8	5.5	3.5
80	18	12.5	—	4	2.5

Volume of pickle liquor: 50 c.c.
Material: as described under Table III.
Average acid consumption: 0.24 grm. of HCl.

TABLE V.—*Effect of Iron Content on Pickling Time for Hydrochloric and Sulphuric Acids.*

Temperature. Deg. C.	No iron.	Iron. Grm. per litre. 10.	20.	40.
	Min.	Min.	Min.	Min.
Hydrochloric acid, 30 grm. per litre.				
25	45	57	57	56
35	25	31	33	37
50	13	14	15	15
Sulphuric acid, 30 grm. per litre.				
35	87	106	121	131
50	46	50	55	60
60	29	34	37	41

TABLE VI.—*Comparison of Pickling Times for H_2SO_4 Pickles at 60 deg. C. with and without Restrainer.*

H_2SO_4. Grm. per litre.	Restrainer— None. Min.	*A.* Min.	*B.* Min.	*C.* Min.	*D.* Min.	Glue size, 0.05 per cent. Min.
30	29	34	34	34	34	34
50	22.5	22	22	22	22	22
80	19	22	20	20	21	21

forming soluble ferrous salts. Solution of the inner ferrous-oxide phase layer has been observed microscopically and confirmed chemically. It is, therefore, considered that scale removal in the case of scales formed at temperatures above 600 deg. C. follows solution of the inner ferrous-oxide phase layer by acid which has gained access to it via cracks and pores in the outer layers. Scale formed at temperatures at

TABLE VII.—*Comparison of Pickling Times for HCl Pickles at 35 deg. C. with and without Restrainer.*

HCl. Grm. per litre.	Restrainer— None. Min.	*A.* Min.	*B.* Min.	*C.* Min.	*D.* Min.	Glue size, 0.05 per cent. Min.
30	25	36	32	37	32	36
50	18	22	25	26	20	25
80	12.5	14	16	15	12	16

TABLE VIII.—*Inhibitor Efficiencies.*

Restrainer.	HCl, 50 grm. per litre at 25 deg. C. Rate of solution. Grm. per sq. cm. per hr. × 10^{-5}.	Percentage inhibition.	H_2SO_4, grm. per litre at 55 deg. C. Rate of solution. Grm. per sq. cm. per hr. × 10^{-5}.	Percentage inhibition.
None ..	70	0	480	0
A ..	3.5	95	8.1	98
B ..	4.5	94	11.9	97
C ..	3.9	95	19.6	96
D ..	5.6	92	6.0	99
Glue size	4.2	94	29.0	94

TABLE IX.—*Effect of Scale on Pickling Time.*

Type of scale.	Time of pickling using H_2SO_4, 30 grm. per litre at 55 deg. C. with— Glue size. Min.	No restrainer. Min.
Electric-welded conduit Produced at—	34	29
900 deg. C.*	50	40
750 deg. C.*	41	35
620 deg. C.*	180	71
520 deg. C.*	300	105

* As described in Table I.

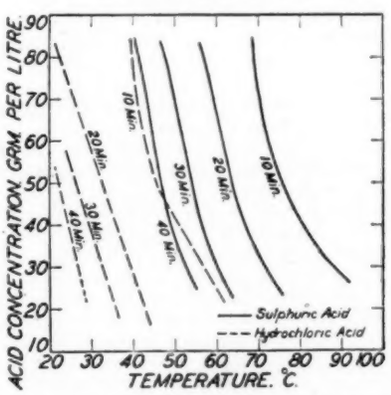

FIG. 7.—ISOCHRONAL LINES FOR SULPHURIC AND HYDROCHLORIC-ACID PICKLING, PLOTTED ON AN ACID-CONCENTRATION/TEMPERATURE BASIS.

Provided that over-pickling is avoided, that is, that inhibitor is used in sufficient amount or the material is taken out of the pickle as soon as the scale is detached, then the acid consumption is directly dependent on the type and amount of scale, being a function of the amount of ferrous-oxide phase. That is to say, the fundamental action in pickling is:—

$$FeO + 2H^{\cdot} \rightarrow Fe^{\cdot\cdot} + H_2O.$$
(Solid)

This is a heterogeneous reaction, and its rate should therefore be dependent on the hydrogen-ion activity, the viscosity of the pickling acid and the diffusion constant. These factors are all influenced by the acid, the temperature, and the amount and character of any additions.

The Noyes-Whitney type of relationship should apply, namely:—

$$\frac{dx}{dt} = \frac{OD}{V\delta}(S - x)$$

where O is the superficial area of the solid reactant,
V the volume of liquid reactant,
δ the thickness of the stationary film,
D the diffusion constant of the acid,
S the initial acid content, or more strictly an activity term, and
x the amount of acid consumed.

Therefore

$$\frac{dx}{dt} = k(S - x), \text{ where } k = \frac{OD}{\delta V}.$$

The rate of pickling is directly proportional to the acid content at constant temperature, provided that the bulk of acid solution is sufficient to avoid appreciable alteration in concentration during pickling. This is confirmed by Figs. 3 and 4.

Integrating the velocity equation,

$$\log\left(\frac{S}{S - x}\right) = kt.$$

Therefore

$$k = \frac{1}{t}\log\left(\frac{S}{S - x}\right).$$

For heterogeneous reactions controlled by diffusion processes, it has been found that the temperature coefficient ranges about 1.3 per

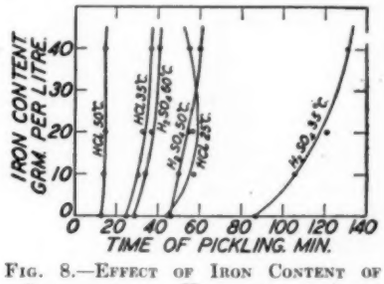

FIG. 8.—EFFECT OF IRON CONTENT OF SULPHURIC AND HYDROCHLORIC ACIDS (30 GRMS. PER LITRE) ON THE PICKLING TIME.

10 deg. C., whilst for monomolecular homogeneous reactions it is of the order of 2 or more.

TABLE X.—*Reaction Constant* $k = \frac{1}{t}\log\left(\frac{S}{S-x}\right)$ *for Sulphuric Acid Pickling.*

H_2SO_4. Grm. per litre.	$\log_{10}\left(\frac{S}{S-x}\right)$	Constant *k* at— 25 deg. C.	35 deg. C.	50 deg. C.	60 deg. C.	80 deg. C.
10 ..	0.524	0.0012	0.0021	0.0053	0.0072	0.011
30 ..	0.1139	0.00054	0.0013	0.0025	0.0039	0.0078
50 ..	0.0656	0.00040	0.00083	0.0018	0.0029	0.0066
80 ..	0.0406	0.00032	0.00070	0.0015	0.0021	0.0051
Average*		0.00042	0.0009	0.0019	0.0030	0.0065
Temp. coeff. for for 10 deg. C. ..			2.1	1.7	1.6	1.6

* Excluding values for 10 grm. per litre.

TABLE XI.—*Reaction Constant* $k = \frac{1}{t}\log\left(\frac{S}{S-x}\right)$ *for Hydrochloric Acid Pickling.*

HCl. Grm. per litre.	$\log_{10}\left(\frac{S}{S-x}\right)$	Constant *k* at— 25 deg. C.	35 deg. C.	50 deg. C.	60 deg. C.	80 deg. C.
10 ..	0.283	0.0011	0.0033	0.0059	0.0077	0.0105
30 ..	0.0755	0.0017	0.0030	0.0058	0.0084	0.015
50 ..	0.0441	0.0013	0.0024	0.0055	0.0080	0.013
80 ..	0.0269	0.0015	0.0022	—	0.0067	0.011
Average		0.0014	0.0027	0.0057	0.0077	0.012
Temp. coeff. for for 10 deg. C. ..			1.9	1.7	1.3	1.3

Values of *k* have been calculated for the various concentrations and temperatures, with results given in Tables X and XI. The constancy for

any temperature is satisfactory, and the temperature coefficient, it will be noted, is of the order required by a heterogeneous reaction. The fact that the log-pickling-time/reciprocal-of-absolute-temperature graphs (Fig. 6) approximate closely to straight lines is also in keeping with a diffusion-controlled process.

Pickling Practice.—Having obtained an idea of the mechanism of the pickling process, attention can now be turned to the practical side. From the foregoing it is clear that within limits it is more important to control the temperature than the acid concentration. Expeditious pickling can be secured with sulphuric acid in concentrations of 30 to 100 grm. per litre at temperatures of 60 to 80 deg. C., and with hydrochloric-acid solutions of similar strengths at temperatures of 30 to 40 deg. C. Since it seems possible by adjustment of the conditions to obtain practically identical results from pickle liquors made up from either sulphuric or hydrochloric acids, the actual choice of acid rests more on economic considerations. In Table XII are set out some of the facts that merit consideration when deciding which acid to employ. Evidently brown oil of vitriol is the cheapest for acid equivalent.

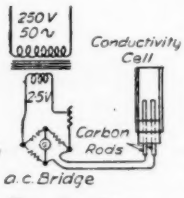

Fig. 9.—Conductivity Bridge.

When sulphuric acid is employed, the pickle liquor requires heating to a much higher temperature to obtain similar pickling activity, as has already been noted (Fig. 7). An allowance for the extra cost of heating should therefore be made when comparing the cost of sulphuric- and hydrochloric-acid pickling. But, allowing 33 per cent. on the acid cost for heating, which

Table XII.—*Comparison of Acids.*

Acid.	Sulphuric. Brown oil of vitriol. (B.O.V.)	Sulphuric. Distilled oil of vitriol. (D.O.V.)	Hydrochloric, commercial. (Muriatic acid.)
Sp. gr. ..	1.70 (140 deg. Tw.)	1.84 (168 deg. Tw.)	1.14 (28 deg. Tw.)
Acid content	77 per cent.	95 per cent.	28 per cent.
Average cost per ton, F.O.R. ..	£3 10s.	£5 10s.	£3 10s.
Cost per lb. equivalent	1.99s.	2.54s.	4.07s.

from works observations is believed to be a generous estimate, the cost of pickling with sulphuric acid purchased as B.O.V. is still much less than that of hydrochloric acid. Therefore, whenever works organisation allows, sulphuric

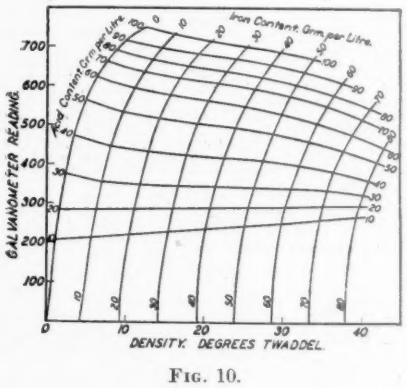

Fig. 10.

acid should be preferred for pickling on these economic grounds. To secure the maximum economy in acid by reducing discarded liquor losses, naturally the pickle liquor should be worked to the highest possible iron and minimum free-acid contents.

If the heating equipment permits working off old liquor at a high temperature, and the layout and handling arrangements allow the use of an old liquor as a preliminary rough pickle, then the iron in the discard liquor may be taken very high and the free-acid content worked down quite low. In such circumstances it should be feasible to pickle until the liquor is half saturated with iron salt at the working temperature, namely, 217 grm. of $FeSO_4$ (80 grm. of Fe) per litre and 272 grm. of $FeCl_2$ (120 grm. of Fe) per litre, respectively, for the two liquors. If the works conditions are not so favourable, and if subsequent operations call for special cleanliness, then the sludge accumulation in the pickle tank may become the determining factor. The best practical limit must be determined according to the particular conditions, but the limits suggested may be taken as an indication of the direction towards which it should be attempted to work as far as other conditions allow.

In general, pickling inhibitors should be used, not solely for the sake of the acid saving that is likely to be made, and which would just be a question of balancing costs, but as an insurance against over-pickling and wastage of valuable material. From the point of view of health and hygiene, the use of inhibitors in reducing spray is also well worth while. In the course of comparative tests on four proprietary inhibitors and glue size in recommended amounts for both hydrochloric-acid and sulphuric-acid pickle liquor, no appreciable difference in restraining action on bare steel was found. There is a general slight increase in pickling time when inhibitors are used, as has already been noted. This is probably due to the reduced agitation following the lessened gas evolution. The choice of restrainer is therefore chiefly a matter of cost, although the stability may also be a consideration. From observations made on the iron dissolved and hydrogen evolved in the presence of various inhibitors, it has been concluded that there are differences in the stability of inhibitors under reducing conditions. Thus, that inhibitor should be chosen which gives the desired restraining action with the minimum cost over the whole useful life of the pickle liquor. The schedules below exemplify practice based on the foregoing considerations. They are not put forward as either exhaustive or of general application, but merely as an indication of the lines along which practice should be organised.

Suggested Practice with Sulphuric Acid.

Initial Liquor.—Make up to 50 grm. of H_2SO_4 per litre by taking 65 lbs. of B.O.V. (140 deg. Tw.) per 100 galls. of water, or 1 part by volume of B.O.V. per 26 parts by volume of water. Density 1.062, or 12½ deg. Tw.

Temperature.—60 deg. to 80 deg. C., best obtained by steam coils; alternatively by steam injection starting with tank only part full to allow for condensation exceeding spillage, thus causing volume to increase.

Maintenance.—Keep free-acid content up to 50 grm. of H_2SO_4 per litre by additions of B.O.V. as necessary, but on no account add more than a total of 250 lbs. of B.O.V. per 100 galls. of tank volume.

Finishing.—Additions should be discontinued when the specific gravity of the liquor reaches 1.17, or 35 deg. Tw. When the final addition has been made, the activity of the liquor should be maintained as far as practicable by raising the temperature, and if possible the tank should be changed over to work as a preliminary rough pickle, if handling and production demands allow. When the activity has fallen below an economic point, probably corresponding to the free-acid content falling below 10 grms. per litre, the liquor should be discarded, and a new bath made up. The discarded liquor should approach: 10 grm. or less of H_2SO_4 per litre; 80 grm. per litre of iron; and specific gravity 1.20, or 40 deg. Tw.

Use of Hydrochloric Acid.

Initial Liquor.—Make up to 100 grms. of HCl per litre by taking 530 lbs. of muriatic acid (28 deg. Tw.) per 100 galls. of water, or 1 part by volume of acid per 2 parts (about) of water. Density 1.045, or 9 deg. Tw.

Temperature.—30 deg. to 40 deg. C. Warm up initially by steam injection or by charging warm material from previous operation. Temperature will then be maintained by the heat of reaction.

Maintenance.—Keep free-acid content between 50 and 100 grms. of HCl per litre by additions of acid as necessary, but on no account add more than a total of 720 lbs. of acid per 100 galls. of tank volume. Additions should be discontinued when the specific gravity of the liquor reaches 1.20, or 40 deg. Tw.

Finishing.—The same remarks apply as for sulphuric acid, and the discarded liquors should approach: 10 grms. per litre of HCl or less; 120 grms. per litre of iron; and specific gravity 1.24, or 48 deg. Tw.

Table XIII gives results of observations of both normal pickling practice and special tests made in various tube mills spread over considerable tonnages of material, as well as some results of laboratory experiments. It will be seen that the acid consumption varies from 0.5 to 0.7 lb. equivalent per 1,000 sq. ft. This is mainly due to variations in the condition of the tubes.

Summary and Conclusions.

The mechanism of scale removal is the same for each acid; when there is a ferrous-oxide phase layer adjacent to the steel base, as is normally the case, detachment of the outer layers follows solution of the ferrous-oxide phase by acid which has gained access to it *via* pores and cracks in the outer layers.

The time necessary for removal of scale is dependent on: (*a*) The temperature and time of formation of the scale, that is, the amount of ferrous-oxide phase and its accessibility as determined by the condition of the outer layers, (*b*) the hydrogen-ion activity of the acid solution, (*c*) the viscosity of the solution, (*d*) the temperature, (*e*) the iron salts, (*f*) agitation. Of these, the temperature, both directly and also by its influence on (*b*) and (*c*), has by far the most important effect on the time of pickling a given material. The relations between the pickling time, temperature and acid concentration in the case of a standard material are in accord with the kinetics of a heterogeneous reaction, as is to be expected.

The acid consumption, apart from mechanical losses, is generally determined by the amount of scale and the proportion that is soluble (that is, the ferrous-oxide phase).

Wherever it is possible to arrange for heating, sulphuric acid should normally be preferred on grounds of much lower cost, even allowing for heating charges.

Working schedules for both sulphuric- and hydrochloric-acid pickling have been put forward.

The variations in thickness of the scales examined indicate that economy in the pickling department is dependent on the annealing conditions, as well as on the organisation of the pickling practice in such a way as to obtain the maximum utilisation of the acid.

APPENDIX—Evaluation of Pickle Liquors.

Simplified methods of titration to give the iron and free-acid contents of liquors are in use for control purposes. These sometimes utilise tabloid chemicals and usually employ vessels calibrated directly in terms of iron or acid concentration, thus permitting such concentrations to be read off directly. Determinations with such apparatus require time to carry them out, and also a certain degree of manipulative skill. It is therefore desirable if possible to devise

methods giving direct indications of the concentrations, thus saving time and enabling operators to obtain results with the minimum of manipulation.

The density of a pickle liquor is mainly determined by the iron content, whilst the electrical conductivity is dependent on the activities of the various ions present, and chiefly the mobile hydrogen ions. It was, therefore, considered probable that a method of evaluation might be used, involving a specific-gravity determination and an electrical-instrument reading bearing some relation to the conductivity. A simple

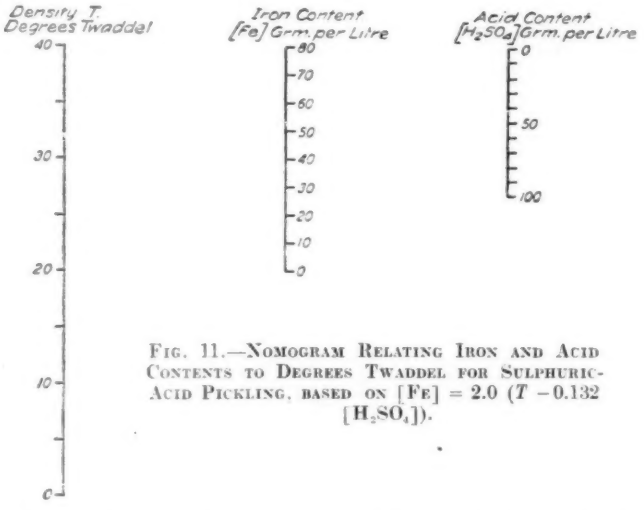

Fig. 11.—Nomogram Relating Iron and Acid Contents to Degrees Twaddel for Sulphuric-Acid Pickling, based on [Fe] = 2.0 (T − 0.132 [H_2SO_4]).

conductivity cell was devised and connected in a bridge circuit with an a.c. galvanometer to indicate lack of balance (see Fig. 9). This was adjusted by trial, and a series of readings was made with synthetic liquors of previously determined specific gravity (Twaddel). From the data so obtained, the graphs (Fig. 10) relating the Twaddel value, galvanometer reading, iron content and acid content were constructed.

With the aid of this diagram, all that is necessary to determine the acid and iron contents of a liquor is to make direct observations of the Twaddel and conductivity-bridge readings, and refer them to the diagram.

The electrical conductivity, like pickling activity, is greatly dependent on the temperature of the liquor. It is possible, therefore, that a conductivity bridge might be adapted to give a direct indication of pickling activity, which, as has been seen, is a function of several factors. The control of a tank would then be very simple. The indicator would be maintained between prescribed limits for pickling activity by attention to the temperature and the acid additions. When either the total acid addition allowed for the tank had been made or the limiting Twaddel value reached, then the liquor would be worked down to its limiting pickling activity and discarded. These possibilities have not yet been explored sufficiently to determine their feasibility. In any case, it is easy to dispense with one titration since the density is, within very close limits, a linear function of the iron and acid contents. Thus, if the density and either the acid or iron contents are determined by titration, then the one not titrated is completely determined. The nomograms, Figs. 11 and 12, based on the relations which apply to H_2SO_4 and HCl pickles, enable calculations to be made with sufficient accuracy for practical purposes.

The procedure is as follows:—(1) Determine the Twaddel value of the liquor. (2) Titrate a standard sodium-carbonate solution with the pickle liquor from a calibrated measuring cylinder, starting from an upper mark. The finishing level of the liquor at the conclusion of the titration enables the acid content to be read directly from the calibration. (3) Align the acid content and the Twaddel value on the nomogram to give the iron content.

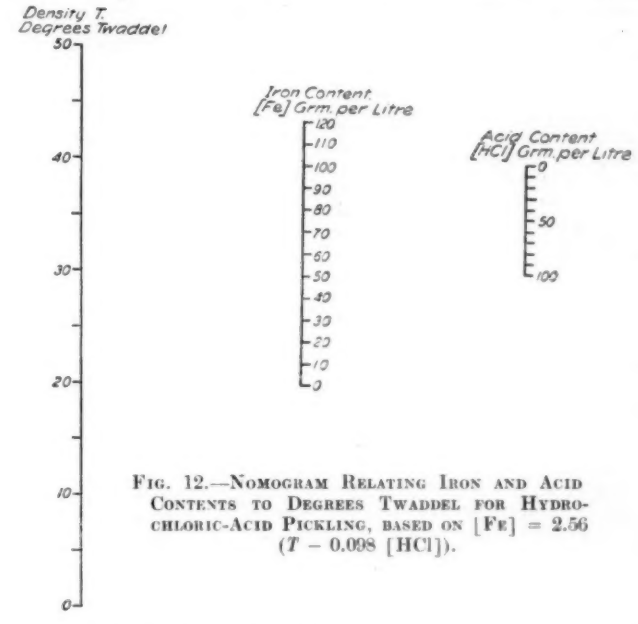

Fig. 12.—Nomogram Relating Iron and Acid Contents to Degrees Twaddel for Hydrochloric-Acid Pickling, based on [Fe] = 2.56 (T − 0.098 [HCl]).

Table XIII.—*Pickling at Various Tube Mills.*

No.	Type of scale.	Acid.	Acid strength. Grm. per litre.	Restrainer.	Temperature, deg. C.	Lbs. commercial acid per 1,000 sq. ft.	Lbs. equivalent per 1,000 sq. ft.
1	Interpass anneal and hot-rolled	HCl, 28 deg. Tw.	100	None	30–35	79	0.60
2	,, ,,	,, ,,	100	*C*	30–35	70	0.54
3	,, ,,	,, ,,	100	Glue size 0.05 per cent.	30–35	76	0.58
4	Mainly hot-rolled ..	,, ,,	30	,,	40–45	69	0.53
5	1½ to 4-in. tubes ..	,, ,,	100	*C*	30–35	78	0.60
	Medium size	,, ,,	100	,,	—	68.5	0.52
	¾ in. and under ..	,, ,,	100	,,	—	94.5	0.72
	Medium..	H_2SO_4 (B.O.V.)	100	,,	60	43.7	0.68
6	Mainly hot-rolled ..	,, ,,	30–40	*D*	60	32	0.50
7	Heavy tubes	,, ,,	40	*C*	60–65	33	0.52
	Light tubes	,, ,,	—	—	—	40	0.63
8	Mainly interpass anneal	,, ,,	40–60	*A*	50–60	35–42	0.55–0.66
	Laboratory experiments:						
9	Welded conduit ..	HCl	Various	With and without	Various	65	0.50
10	,, ,, ..	H_2SO_4 ..	,,	—	,,	32	0.50

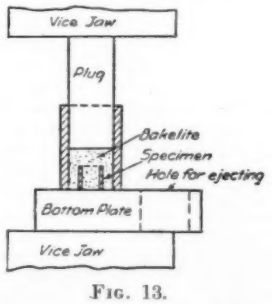

Fig. 13.

APPENDIX II.—Mounting of Scale-Coated Steel for Microscopic Examination.

By T. W. Lewis.

Difficulties were experienced in making sections of scale *in situ* on the steel base, and the method of preparation finally adopted seems capable of general application where edges or coatings have to be sectioned. Some details of the technique will therefore not be out of place here. The specimens used in this research were embedded in bakelite mouldings and ground and polished in the usual way. It was found possible to make the mouldings in a laboratory workshop without any special press equipment by using the ordinary commercial black bakelite moulding powder (synthetic resin plus wood-flour filler).

A simple press mould was improvised from a short length of steel tube with a sliding plug and a flat end-plate. All these parts were heated to 240 deg. C.; they were then placed in a vice (arranged with its jaws horizontal and screw vertical), the specimens were inserted together with sufficient moulding powder, and pressure was applied and maintained for 3 min. After this period the moulding was pushed out by means of a stripper plate. Fig. 13 shows the type of mould used.

A valuable feature of bakelite as an embedding agent is that it is impervious and electrochemically inert, and so does not introduce difficulties in etching such as arise when fusible metal or plated coatings are employed. This particular method of using synthetic resin obviates the disadvantages associated with its use in the form of a liquid varnish, when the medium generally becomes very porous on account of blistering during the protracted stoving which is necessary.

Institute of British Foundrymen.

SHEFFIELD SECTION.

At the first meeting of the session of the Sheffield Section of the Institute of British Foundrymen, held at the Grand Hotel, Sheffield, on September 23, Mr. C. D. Pollard delivered his presidential address, in the course of which, after thanking the members for the honour they had accorded to him, said he hoped the members would help by attending the meetings and, whenever possible, join in the discussions. During the session there is to be a series of lectures of a varied character, by some of the most prominent men in the industry, and he hoped that Sheffield would do justice to each speaker by according him a good reception, followed by keen discussions. They were fortunate in having such a splendid programme arranged, and he congratulated Mr. Walker and the members of the Council on this achievement. Regarding the affairs of the Branch, he refrained from quoting figures relating to membership or finance, but pointed out that numerically they had suffered serious reductions, and yet he was satisfied that they could make up the leeway if they were sincere and enthusiastic. Without doubt, some other Branches had also lost members, but even so it would be to their advantage if they reviewed their own affairs, in an effort to decide a basis upon which they might draw more members into the Branch. Indeed, the whole of his remarks were inspired by a feeling of anxiety and a desire to improve the position, and he trusted that the members would reciprocate by offering constructional opinions.

The Southern Trend of Business.

In the transition period through which we have been passing, Sheffield had been left with empty shops, and this Branch had a declining membership. Bad trade was one of those reasons, and also the tendency towards the transference of production for engineering trades to the southern area of the country. This has been noticeable for some time, and must result in a diminishing output from such places as Sheffield. Then it must be realised that a large proportion of the work which used to be turned out by the local foundries was of the heavy class, and because of the changes in requirements, made necessary by the call for lighter machinery, those heavy castings would not be required in such large quantities in the future. This feature is one which should have careful attention, because one must consider as to whether the local foundries were equipped to meet the demands of the change-over from the production of the heavy to the lighter class of castings. In this direction they were not so well placed as could be desired. There had been a feeling of security and pride among Sheffield foundrymen in the past that they were entrusted with the production of some of the most important castings required for special service, and that feeling of security had led them into a lethargic attitude towards the future, and they were in danger of losing their grip on the home markets, as well as those abroad. He specially directed his remarks to those foundrymen who had been members of the Branch or who had had the opportunity of being members during the years that had elapsed since the end of the war. In general principle, they had no such body of specialists as the British Cast Iron Research Association to guide the steel-casting producers, but the Council had arranged many and varied lectures by some of the most prominent scientific and practical men, who had come to Sheffield and given them the benefit of their knowledge, and yet there had always been difficulty in obtaining contributions from Sheffield steel founders.

The steel foundrymen of Sheffield had for some considerable time refused to take the opportunities afforded them by this Branch for a closer study of what had been going on outside their own city. Possibly there had been a tendency to be too careful not to divulge what was happening in their own shops, and in consequence they had either stayed away from the Branch meetings or kept silent when they attended, which had resulted in ironfounders and chemists being called on to fill the gap. What effect had this had on their journeymen and youths, who a few years ago were in full work, and justly proud of the large or comparatively large castings which were being turned out from their shops? Were they, along with their foremen, sufficiently versatile to be able to accept the change of work, and, when the efforts of the sales organisations were rewarded by orders for the lighter work, be competent enough to produce those castings at competitive prices?

Sheffield business men were determined to have their share of the work which would sooner or later be distributed, and they must be prepared to meet the situation. This was a matter for real team work, and whereas some of our members had had opportunities of studying methods adopted in other towns, or even abroad, the craftsmen in the shops were the backbone of the foundry trade in Sheffield, and unless those who were in administrative positions encourage them to attend technical meetings, and if only occasionally they express their opinions, one cannot expect them readily to adapt themselves to the drastic upheaval of the methods taught them when they were learning their trade.

It had been his privilege in the years 1929 and 1930 to be President of the Foundry Section of the Sheffield Trades Technical Society, and during that time he gained an insight into what might be termed the opinion of the man in the shops. The majority of the men attending the meetings of the Society had not had any previous technical training, and were really seeking an understanding of the correct interpretation and meaning of the application of science to industry. It was pleasing to note that the steel moulders and coremakers of Sheffield were well represented. Now there was some reason why such men do not now attend Branch meetings, and he did not believe the financial barrier to be the only reason. Although these remarks were addressed primarily to steel foundrymen, ironfounders were involved in this matter. There were journeymen who would talk for the sake of talking in preference to getting on with their job, but there were others whose experience might be valuable, providing they were given an opportunity of expressing themselves at the right time.

Team Work.

For this there was no hard-and-fast rule. Each shop had its local conditions, and success would be achieved in those shops only where team work was rigidly observed. They must retain the reputation for castings which had been theirs for such a long time, but to do so they must accept the challenge of the purchasers and produce at lower costs whilst maintaining the high standard if at all possible. Production at lower costs it must be, but the question of maintaining the standard of quality was a debatable one. Were they justified in insisting on producing all their castings with the "Sheffield" finish, or must they waive this attitude and despatch them in a rough and badly-finished condition. Buyers of castings think in £ s. d., but the engineers and inspectors were still very keen on castings with a good finish.

Design and Designers of Castings.

Production costs were affected very largely through lack of sympathy and co-operation between designers and draughtsmen and the people in the foundries. Steel founders suffered in this direction far more than the majority of the producers of cast iron, because the facilities for budding designers to spend some time in iron foundries were greater than could usually be arranged for them to go into steel foundries. Most of the large engineering concerns of this country who purchase steel castings were producers of iron castings, which meant direct touch between drawing office and cast-iron production, and in consequence in many cases, from a design point of view, what was good for iron was asked for in steel. It should be our endeavour to bring the designers into the team and if they were fortunate enough to have any draughtsmen or designers amongst their members he hoped they would make every endeavour to gain sufficient experience to prove the difference between making iron castings and steel castings. They must realise that it was idle to gain experience in either iron or steel and rigidly apply approved remedies for one to cure production difficulties when dealing with the other. On the other hand it was only fair to the designers that foundrymen should offer candid opinions and helpful suggestions whenever they had the opportunity.

Alloyed Castings.

Another phase of present-day conditions was the gradual increase in the use of alloying elements in the making of iron and steel castings, and the special heat-treatments adopted to put those products into specified physical conditions. This was evidence that the practical application of science to industry was an accepted fact in the foundries. Sheffield could claim to hold its own in the production of alloy castings, and was ready to meet any demands for the highest quality in this class of product. This was no empty boast, and he based his remarks on the knowledge that there were men in Sheffield who were the keenest of pioneers in scientific research work. He referred specially to-night to the award of the "Oliver Stubbs" medal to Mr. J. E. Hurst for the great work he had carried out in connection with the heat-treatment of cast iron. This was the highest honour which the Institute could bestow on any of its members and was granted annually for efforts made to advance knowledge in the practice and theory of founding. He congratulated Mr. Hurst, and asked him to accept their thanks for devoting so much time, thought and energy to this subject, and in addition, the thanks of all foundrymen were due to him for his contributions to the technical press.

Reverting to the question of alloy castings, whether they be steel or iron, which made possible a wide range of choice to the engineer and the designer, he suggested to these people that the producers of the castings were the best judges of the analysis and treatment to be adopted for any specific job, and not they themselves. He recommended that foundries were supplied with information regarding the service conditions, test requirements, stress loads and the like, but, having done this, the engineers should leave the foundrymen to decide what was the most suitable analysis for the metal to be used, and the treatment to be given, in order to meet the specified requirements of the purchaser. Co-operation between designers or engineers and ourselves was the ideal way of dealing with the question, but where that was impossible he advised the engineer to give all the information he could of service conditions and leave the remainder to the founder.

Skilled craftsmen might not be required in foundries to-day in such large numbers as

hitherto, but so long as castings were made experienced tradesmen would be necessary, and one of the most serious aspects of the present state of trade throughout the country was the lack of opportunity for the training of boys. It was a matter for regret that the education of apprentices in foundries had been interfered with on account of the empty shops, as this state of affairs prevented the boys from obtaining the very important practical side of their education. There were various schemes for the special training of boys and youths at universities and schools in other towns as well as locally, and vocational training was of more use to youths than the old method of teaching, but unless a fairly large percentage of the boys who attended special evening classes gained practical experience on production work, we should be short of skilled craftsmen in the future. This, again, was a matter for consideration by all members because they must give attention to the boys now if they were to maintain the good name of which Sheffield was so proud. The shortage of work makes it difficult, and mass-production methods add to the lack of opportunity for boys to gain an all-round experience, but where opportunities could be afforded to boys he hoped that every encouragement would be afforded them to learn their job thoroughly and to attend classes at the same time.

In conclusion he asked the members to accept all that he had said in the spirit in which it was given and to give all the help they could to the Council and Secretary in their efforts to improve the Branch conditions, and by so doing they would have the satisfaction of knowing that they were all endeavouring to make the foundrymen of Sheffield into a good team.

Mr. G. L. Oxley said there had been a declining membership despite the fact that the programmes of lectures for the past few years had improved. He thought that the programme for the coming session was even better than they had had for some time. He wondered if the members wanted more practical lectures. If so, would someone come forward and give them?

Mr. Geo. Edgington said he was very interested in what the President had said about the training of apprentices. At Chesterfield they had a foundrymen's class in connection with the Technical College there. It was held at Markham's works. Boys came to the classes from the foundries and worked from patterns. One of the foremen acted as tutor. He thought the scheme was a good one. The boys went into the shop and saw the work actually being done as it was being done every day.

Mr. Offiler said he was afraid that pattern-making was only interesting to the pattern-maker. He did not think the moulder was so much interested in it. From that standpoint it was rather disappointing that they had not more lectures that would give them a fair insight as to the actual work necessary in the making of a pattern. Such work was not always seen by the purchaser, but it was always seen by the moulder. The moulder appreciated the work put into the pattern, for it assisted him considerably.

The Hon. Secretary (Mr. T. R. Walker) said that he actually arranged a Paper last year to be given by a patternmaker, but the person who was to have given it was taken ill and the lecture had to be cancelled. They might try and arrange for it to be given this year.

Referring to what the President had said about there being a tendency for people to be over-careful not to divulge what was happening in their shops, Mr. S. Leetch said that one of the great difficulties was that a brake was put on elsewhere. If the Institute could by any means influence the governing bodies of steel foundries to allow members of their staffs who were capable of giving Papers to do so it would be of considerable value.

Dr. J. G. A. Skerl said he thought the moulders were quite as conservative as the employers in their own way. No one was more conservative than a foreman in a steel foundry. He was much more conservative than the people above him. In regard to the question of youths, how many youths did they see in a steel foundry or an iron foundry in these days? There were no young moulders. If they saw a young man in a shop they could generally assume that he was a labourer. The education of the moulder, especially of the apprentice, had been very much neglected in Sheffield. Schemes had been brought forward from time to time to give the apprentices certain part-time education at the secondary schools and following up to the university, but during the last 10 years there had only been one applicant, and he soon left the moulding trade. The university itself had tried to assist the people above the apprentices' stage, and that was the reason, as they were well aware, for the starting of the technical classes at the university, but the whole point, it seemed to him, boiled down to the intense conservatism that permeated the steelfounders of the city. Although he partly agreed with Mr. Leetch about the brake being put on, he thought it was also put on by the men themselves.

The President said they must accept the fact that there was conservatism in Sheffield, but who could say whether it was more on the employers' side than the employees? He agreed with Dr. Skerl that probably there was a little more on the employees' side than on the employers'. Having voiced their opinions as a representative body of foundrymen in Sheffield they had done their duty, and so long as they, as members of the Institute in Sheffield, were not afraid to do their duty to themselves and the trade, he was convinced that good would come of it. They might strike at the heart of that conservatism in the city if they could get foremen, charge-hands, managers or tradesmen to come and give their opinions on how to run a steel or an iron job without giving trade secrets away.

Mr. G. C. Castle supported the President's remarks and suggested that a *résumé* of the presidential address should be sent to all the members and to the firms in the district. He felt that great good would come of this. He moved a vote of thanks to Mr. Pollard.

Mr. Oxley seconded, and also expressed appreciation of Mr. Castle's services as President during the past year.

"Guaranteed" Castings.

(*Concluded from page* 218.)

short discussion on anything of interest of which they had heard or read during the past month.

Mr. F. W. Nicholson, referring to the point raised by Mr. Dawson on the subject of classes, mentioned that a good class on foundry metallurgy was assured in Newcastle for the current session. Some difficulty, however, was anticipated for the next session on account of the present lack of applicants for the first- and second-year foundry courses. Probably this was due to the prevailing trade depression as very few new apprentices were being taken on in local foundries just now, but he appealed to all members to do their best to secure greater interest in these classes.

Mr. Gresty proposed a vote of thanks to Mr. Scott for his presidential address and said that the interesting discussion they had had on his remarks was good evidence that it had been thoroughly enjoyed. Mr. Scott briefly thanked those present for their reception of his remarks and for their vote of thanks.

A discussion on delivery promises—their making, keeping and breaking—took place at the first ordinary meeting of the Scottish Branch of the British Works Management Association, held on Monday in Glasgow. Mr. J. B. Mavor, of Messrs. Mavor & Coulson, Limited, President of the Branch, initiated the discussion.

Scottish Foundry Industry.

(*Concluded from page* 220.)

McNab. The Paper was the one for which Mr. McNab was awarded the John Surtees Gold Medal. It had been their custom to ask the author of the winning Paper to read it at the meeting, but Mr. McNab had, as most of them were aware, gone to take up an appointment in Singapore, and Mr. Evan Ross, who had for many years been very closely associated with the author, had kindly consented to read the Paper. (This will appear in a future issue.)

The late Mr. Tom Bell.

The President said that, as most of them knew, the Branch had sustained a loss since they last met by the death of one of their Past-Presidents, Mr. Tom Bell. He would ask Mr. Campion to say a few words in this respect, as Mr. Campion knew Mr. Bell and he himself did not.

Mr. A. Campion said Mr. Bell was one of the original members of the Branch, in fact he was one of the small group who met before the inaugural meeting to discuss the desirability of forming the Branch. He worked very hard in the interests of the Branch during its earliest days and did much to ensure its success and helped in laying the foundations for becoming as it is to-day, the second largest Branch of the Institute. Mr. Bell was of a somewhat inquiring turn of mind and always on the search for new experience, which led him to leave Scotland and to work in other spheres in order to gain further knowledge of the trade, so that he did not attain the Presidential chair until 1927. He took up the duties of the office with keen enthusiasm and great seriousness: he directed all his energies to the advancement of the Branch and the Institute. Unfortunately his health broke down in the middle of his term of office and was prevented from giving that attention to the duties he desired. His interest was so keen that when it came to the time for his successor to take office, he insisted in being brought to the meeting in order that he might introduce his successor despite the fact that he was in such a condition that most of his friends considered he should not have been from home. That was an indication of Mr. Bell's keen interest in the Branch and its welfare. It was an example that some of our members might well try to emulate. Mr. Bell passed away in the early summer and those of us who knew him most intimately feel that we have lost not only a keen foundryman but a dear old friend. His son is a member of our Branch and has taken a part in the junior meetings.

Mr. J. Longden said that Mr. McManus, the retiring President, had put in a year's very hard work during his term of office, and he thought that they ought not to allow him to pass on without first expressing their sense of gratitude for the manner in which he had carried out the duties and the large amount of work which he had done. He therefore proposed a very hearty vote of thanks to Mr. McManus.

The vote was received with acclamation.

Mr. McManus then thanked them for the vote of thanks, saying his term of office had been most interesting and happy.

Trevithick Centenary.—We learn on good authority that a movement is on foot among the engineering profession to mark in an appropriate manner the centenary, in April next year, of the death of Richard Trevithick, one of the greatest of our engineers. A meeting of representatives of engineering institutions has been called for Thursday, October 20, at 5.30 p.m., at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, the Council of which has generously placed accommodation at disposal for the purpose. Engineers generally, interested in the proposal, are cordially invited to attend. The movement was started by the Newcomen Society for the Study of the History of Engineering and Technology, the hon. secretary of which is Mr. H. W. Dickinson, Barn Field, Riddlesdown Road, Purley, who will be pleased to answer inquiries.

XUM

This Week's News in Brief.

Trade Talk.

Messrs. Frank Young & Son, metal and scrap merchants, have removed from 85, Lord Street, to Windsor Works, Gore Street, Liverpool.

The United Upper Silesian Smelting Works, of Gleiwitz, has secured an order for the delivery of 12,000 railway carriage axles to Soviet Russia.

The next annual melting of the American Society for Testing Materials will be held at The Stevens, Chicago, Illinois, from June 26 to 30, 1933, during the Century of Progress Exhibition.

At the Millom Ironworks, Cumberland, of the Millom & Askam Hematite Iron Company, Limited, where one furnace only has been operating for some time, a second furnace has been put into blast.

The Furness Shipbuilding Company, Limited, Haverton Hill-on-Tees, have secured orders for dock gates at the new fish dock at Grimsby, and also for several hundred tons of structural steelwork for London.

Imports of foreign iron ore at Prince of Wales Dock, Workington, in the quarter ended September 30 amounted to 27,000 tons, as compared with 32,300 tons in the previous three months and 25,840 tons in the corresponding period of last year.

Messrs. Black & Decker, Limited, of Slough and the United States, manufacturers of portable electric tools and fractional horse-power motors, are making arrangements to extend their British output, owing, it is stated, to the imposition of the new import duties.

Although the building of the new Cunarder at Clydebank by Messrs. John Brown & Company, Limited, is suspended, work on the rudder for the vessel has been proceeding at the Darlington Forge, Limited, and will be finished in about three weeks' time. It is understood that the fact that work on the rudder is proceeding has no significance so far as the rest of the vessel is concerned.

Several sheet and tinplate works in South Wales were restarted last week, or will be restarted in the near future. They include the Llanelly Sheet Mills, which have been idle for nearly a year; the Kidwelly Works, and the Copper Miners Tinplate Works, Cwmavon, both of which have been at a standstill for a considerable period. Other works where there are stated to be prospects of an early resumption are the Ashburnham Works, Pembrey, the Llangennech Tinplate Works, the Dafen Works, Llanelly, and the Gwalia Tinplate Works, Briton Ferry. On the other hand, Messrs. Baldwins' King's Dock Works, Swansea, have been closed down for an indefinite period.

Extraordinary general meetings were held in London on September 28 of the Cobalt Magnet Steel Company, Limited; Nelson Tool Company, Limited; Sybry, Searls & Company, Limited; Darwin & Milner, Limited; Hos-Syb Works, Limited; Spartan Steel Company, Limited; Beeley Wood Steel Company, Limited, and Sheffield Annealing Works, Limited, all of which have their registered offices in Carlisle Street, Sheffield. At each company's meeting a resolution was passed that the company be wound up voluntarily, and that Mr. J. T. Rankin, of Williams Deacons Bank Chambers, Church Street, Sheffield, be appointed liquidator, and that the liquidator be authorised to distribute the assets of the company in specie to the members entitled to such.

The Newcastle-upon-Tyne Electric Supply Company, Limited, with the beginning of October, absorbs eight large companies with which it has been associated for many years. The companies which will be dissolved are:—County of Durham Electric Power Supply Company; County of Durham Electrical Power Distribution Company; Cleveland & Durham County Electric Power Company; Cleveland & Durham Electric Power Company; Northern Counties Electricity Supply Company; Houghton-le-Spring & District Electric Lighting Company; Carville Site & Power Company; and the Tees Power Station Company. The united companies will be known as the North Eastern Electric Supply Company, Limited, with headquarters at Carliol House, Newcastle.

Quenching oil can be cleaned by passing through a centrifugal or stationary filter.

Company Reports.

Hopkinsons, Limited.—Interim dividend of 2½ per cent, less tax, on the ordinary shares.

Vulcan Foundry, Limited.—Dividend on the ordinary shares of 2½ per cent. for the year ended June 30.

Thos. Firth & John Brown, Limited.—The directors do not feel justified in paying any dividend on the preference share capital.

Thos. W. Ward, Limited.—Debit balance, £23,604; transferred from reserve, £10,000; brought in, £31,891; carried forward, £18,287.

Parsons Marine Steam Turbine Company, Limited.—Profit, £10,244; brought in, £32,221; dividend of 5 per cent., £10,564; carried forward, £30,944.

Parkinson & Cowan, Limited.—The directors have decided to defer consideration of the payment of a preference dividend until the accounts for the period ending December 31 next are available.

Tube Investments, Limited.—Dividend of 8 per cent. on the ordinary shares for the year ending October 31, 1932, and at the relative rate on the liaison ordinary shares.

Ferranti, Limited.—Net profit, £54,904; brought in, £35,980; preference dividend, £29,549; ordinary dividend of 6 per cent., £18,000; expenses of capital issue written off, £1,790; carried forward, £41,545.

Kayser, Ellison & Company, Limited.—Profit, after providing for debenture interest, £5,103; brought in, £9,975; no dividend on the ordinary shares; carried forward, after payment of preference dividend, £9,078.

Sheepbridge Coal & Iron Company, Limited.—Net profit, £82,691; brought in, £87,260; ordinary dividend of 5 per cent.; to reserve, £20,000; carried forward, after payment of preference dividend, £83,025.

Stewarts & Lloyds, Limited.—Interim dividends for the half-year ended June 30, 1932, of 3 per cent. on the first preference shares, 5 per cent. on the second preference shares, and 2½ per cent. on the third preference shares.

British Piston Ring Company, Limited.—Net profit, £24,205; brought in, £7,950; preference dividend, £1,500; dividend of 10 per cent. and a bonus of 2½ per cent. on the ordinary shares, making 12½ per cent.; to reserve, £10,000; carried forward, £8,156.

Ransome & Marles Bearing Company, Limited.—Net profit, £21,153 (after writing off £20,878 for depreciation and providing reserve for income tax of £7,000; brought in, £26,625; dividend for the year of 5 per cent.; to reserve, £5,000; carried forward, £24,029.

Palmers Shipbuilding & Iron Company, Limited.—Loss, after providing for maintenance of idle departments, £73,757; interest on 6 per cent. first mortgage debentures, £15,110; debit balance brought in, £30,972, making the amount standing at debit of profit and loss account, £119,839.

British Aluminium Company, Limited.—The directors have decided to pay on October 1 next a dividend at the rate of 6 per cent. per annum, less tax, on the preference shares for the six months ended June 30. The full year's trading results will be awaited before consideration of the payment of a dividend on the ordinary shares.

Contracts Open.

Delhi, November 7.—Electric capstans and fairleads, for the Indian Stores Department, Delhi. The Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1. (Fee 10s., non-returnable.)

Epsom, October 24.—Two borehole pumps and one high-lift pump, electrically-driven, for the Urban District Council. Mr. T. N. Young, engineer-manager, Water Department Offices, East Street, Epsom.

Lahore, November 30.—Two 80-ton overhead electric travelling cranes, for the North Western Railway, Lahore. The Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1. (Fee 5s., non-returnable.)

Personal.

Mr. Arthur S. Young has been elected Master of the Founders' Company.

Mr. Archibald McKinstry has been appointed managing director and Lieut.-Col. J. H. M. Greenly deputy-chairman of Messrs. Babcock & Wilcox, Limited.

Mr. F. E. Rebbeck, chairman and managing director of Messrs. Harland & Wolff, Limited, has been elected a director of National Shipbuilders Security, Limited.

Mr. F. C. Bovenschen has taken up the appointment of Director of Army Contracts in succession to Sir Francis Osborn, who has retired from the public service. Mr. Bovenschen has been Deputy Director of Contracts.

The many friends of Mr. J. Gray Buchanan, J.P., the senior partner of William Jacks & Company, will learn with pleasure that his eldest son, Mr. William Gray Buchanan, of Penang, was married last Friday to Miss Doris Younger, of Edinburgh.

Mr. Guy Locock was appointed a director of the Federation of British Industries at a meeting of the Grand Council of the Federation last week. Mr. Guy Locock began his career in the Foreign Office, but in 1918 he was attached to the Department of Overseas Trade on the formation of that department. He joined the Federation of British Industries as Assistant Director in 1919.

Mr. G. R. Campbell has been invited by the Darlington General Purposes Committee to be the town's next Mayor. Mr. Campbell, who has been a member of the Council for seven years, is associated with Messrs. Fergusson, Wild & Company, Limited, iron-ore merchants, and a director of the Chemical & Insulating Company, Limited, Darlington, and the Eston Sheet & Galvanising Company, Limited, Darlington.

Lt.-Col. Arthur Neale Lee was installed as Master Cutler at Sheffield Court House last week. Colonel Neale is a director of Messrs. Walker & Hall, Limited, cutlery manufacturers. The retiring Master Cutler is Mr. Joseph Ward, of Messrs. Thos. W. Ward, Limited. The new Senior Warden of the Cutlers' Company is Mr. Charles J. Walsh, who recently retired from the position of managing director of Messrs. Ibbotson Bros. & Company, Limited. Mr. Alexander Williamson is the new Junior Warden.

Wills.

Inchcape, Lord, shipowner, chairman of the P. & O. and other shipping companies £2,124,707

Obituary.

Mr. Alfred Austin, who for 37 years represented the Cannon Iron Foundries, Limited, Deepfields, died recently.

Herr Louis Hagen, a prominent German industrialist, died on September 29 at Cologne, at the age of 77. He was associated with several leading German industrial companies and banks, including the I.G. Farbenindustrie, A.E.G. (German General Electric Company), Phœnix Mining & Smelting Company, and the Rhenish Lignite Company.

Don Tomas de Zubiria e Ibarra, Conde de Zubiria (a title conferred on him in 1907), died recently. Those who attended the Iron and Steel Institute meeting at Bilbao in September, 1928, will remember Count Zubiria as President of the Reception Committee. For many years he held a leading position in the heavy iron and steel industry of Vizcaya, and sat on the board of directors of the Altos Hornos de Vizcaya, among other large industrial concerns. For more than 20 years he sat in the Spanish Congress and Senate for the Vizcaya district.

New Companies.

Non-Corrodal Alloys, Limited, Craven House, Kingsway, London, W.C.—Capital £5,000. Directors: H. Pearce and L. G. Grace.

George Jennings (Lambeth), Limited, Stewart's Lane, Battersea, S.W.—Capital £25,000. Metal founders. Director: G. A. Ridley.

J. Gwili Jenkins, Limited, Manoravon Works, Morriston, Swansea.—Capital £2,000. Metal merchants. Directors: J. G. and Mrs. C. Jenkins.

REFRACTORIES

FOR EVERY SERVICE

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FIRECLAY AND
PLUMBAGO

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Raw Material Markets.

Conditions continue to be favourable to a recovery in business, but unfortunately there is a general lack of confidence among consumers, typified in the general absence of forward buying in both the iron and steel departments. Market sentiment may be strengthened, however, by the impending readjustment of the iron and steel import duties and the possible opening of new markets following the ratification of the Ottawa agreements. With reference to the former, there is a general belief that the rates of duty will be increased.

Pig-Iron.

MIDDLESBROUGH.—Although consumers are paying very close attention to the market situation, actual buying is at a low ebb. The number of small parcels bought week by week does not aggregate to a very large tonnage, and it is reported that stocks at the makers' works are again tending to increase. Consumers have little inducement to enter into forward contracts, however, as there are such ample supplies available and there is little possibility of an increase in rates. The future rests entirely upon the possibility of a revival in the consuming industries. The official prices remain, for local sales:—No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

The demand for East Coast hematite has decreased rather than increased since the extra furnaces were put into commission, and the disposal of the additional output has become rather a problem. Hence the lower quotation of 59s. per ton for mixed numbers is being freely shaded for anything more than odd truck lots; this in spite of the fact that the makers claim that the cost of production is not being covered.

LANCASHIRE.—Although the expected revival in contract buying has failed to materialise, reports indicate that deliveries into consumption are maintaining their level, in spite of the increased competition of scrap material. There has been a slight increase in activity at the jobbing foundries since the settlement of the textile dispute, the light-castings producers remaining the best employed. For delivery to works in the Manchester area, Staffordshire, Derbyshire and Cleveland No. 3 are all on offer at 67s. per ton, Northants at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at about 84s. 6d., West Coast hematite at around 81s. and Indian iron at from 67s. to 74s. Machinery scrap is still obtainable at from 30s. to 35s. per ton, according to quality, including delivery.

MIDLANDS.—Little has yet been seen of the expected recovery in the demand, largely owing to the continuance of short-time activity in most of the consuming industries. Few of the foundries have sufficiently strong order-books to be able to contract for supplies more than one month ahead. Prices are unchanged at the controlled levels of 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffs and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations.

SCOTLAND.—The poor conditions at the foundries continue to confine business to little more than day-to-day requirements. There is still only one furnace in operation producing pig-iron. There is no alteration in the official minimum price of 67s. 6d. f.o.t. furnaces for No. 3 foundry, with 2s. 6d. extra for No. 1. Middlesbrough No. 3 is still obtainable at the special price of 55s. 6d., f.o.t. Falkirk, while Northamptonshire foundry is at 54s. per ton at Falkirk.

Coke.

In the aggregate, the demand for foundry coke has shown no improvement, few ironfounders booking ahead. Prices are unchanged, with best Durham foundry coke between 36s. 9d. and 38s., and other grades down to 34s., at Birmingham. The price of Welsh coke still varies to a considerable degree, according to the quantity and quality involved, and figures range from 30s. up to 45s., delivered Birmingham and district.

Steel.

Quiet conditions generally have developed in the steel markets, according to the official report of the London Iron and Steel Exchange. Owing to the possibilities of new duties, few transactions of any importance have taken place in foreign material for the home market for the past week or two. In the semi-finished steel department, business has been limited to comparatively small parcels, most of the business transacted having gone to the British works; but the demand is likely to be restricted until the uncertainties of the situation with regard to the duties have been removed. The demand for finished steel has been irregular, and while some departments have been fairly busy in others business has declined. Several of the export markets are rather more active, but, on the whole, business both for home and export is disappointing.

Scrap.

Conditions in the scrap market show no improvement. Buying remains in abeyance, while supplies are excessive. Merchants, generally, have made no further cuts in their quotations, as they realise that such a policy would not stimulate much buying, owing to the lack of activity at the foundries. In two centres, namely, Scotland and South Wales, prices of machinery scrap have levelled down slightly, but otherwise the position is unchanged.

Metals.

Copper.—The duty of twopence per lb. to be imposed on foreign copper under the Ottawa agreement is exciting considerable discussion in consuming circles, and it is feared that the duty will be passed on to the industrial user, as in the case of lead. Under the articles of the treaty, the duty may be removed if at any time the Empire producers "are unable or unwilling to supply these commodities at first sale in the United Kingdom at prices not exceeding world prices and in quantities sufficient to supply the requirements of United Kingdom users," but it is felt that the phrases "first sale" and "world prices" are liable to lead to misunderstandings; the first, indeed, seems to associate itself with a monopoly. It is possible, however, that these clauses may be subsequently tightened up. Copper itself during the past week has weakened slightly, owing to the irregular state of consumption and the relapse in the stock markets, but it is felt that any increase of activity in the consuming industries would soon bring about a revival.

Closing quotations :—

Cash.—Thursday, £32 13s. 9d. to £32 15s.; Friday, £32 10s. to £32 11s. 3d.; Monday, £31 15s. to £31 16s. 3d.; Tuesday, £31 15s. to £31 16s. 3d.; Wednesday, £32 8s. 9d. to £32 11s. 3d.

Three Months.—Thursday, £32 16s. 3d. to £32 17s. 6d.; Friday, £32 12s. 6d. to £32 13s. 9d.; Monday, £31 18s. 9d. to £32; Tuesday, £31 17s. 6d. to £32; Wednesday, £32 12s. 6d. to £32 15s.

Tin.—A temporary lull in the market, natural after the recent rise in price levels, has been aggravated by news of a fall in the stock markets, which seem to possess unnecessarily large influence over the fluctuations of the metal markets. Were consumption to improve, it would, of course, again become the dominating factor.

Official closing prices :—

Cash.—Thursday, £149 2s. 6d. to £149 5s.; Friday, £148 17s. 6d. to £149; Monday, £148 to £148 5s.; Tuesday, £149 7s. 6d. to £149 10s.; Wednesday, £151 10s. to £151 12s. 6d.

Three Months.—Thursday, £150 10s. to £150 15s.; Friday, £150 7s. 6d. to £150 10s.; Monday, £149 7s. 6d. to £149 10s.; Tuesday, £150 10s. to £150 15s.; Wednesday, £152 12s. 6d. to £152 15s.

Spelter.—Activity has fallen away slightly during the past week. Business with consumers, which showed improvement during the months of August and September, has now fallen away again, owing to the fact that many of the consuming works have covered their requirements for the next two or three months.

Daily fluctuations :—

Ordinary.—Thursday, £14 17s. 6d.; Friday, £14 13s. 9d.; Monday, £14 10s.; Tuesday, £14 12s. 6d.; Wednesday, £14 17s. 6d.

Lead.—The industrial demand for lead, both in this country and on the Continent, is at a low level, and large supplies of metal are on offer. Hence the break in the market this week, following the weakness in general sentiment.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 8s. 9d.; Friday, £12 5s.; Monday, £11 17s. 6d.; Tuesday, £11 16s. 3d.; Wednesday, £12 2s. 6d.

A New Steel-Making Process.

(*Concluded from page* 219.)

ployed on the day-to-day production of light-steel castings.

(2) We saw the end of heat No. 267 and the whole of heat No. 268, from charge to tap, a process taking 2½ hours. It was clear that methods had been so standardised as to leave the conduct of the furnace in the hands of a young workman.

(3) The slags lying about were light coloured indicating low metal losses.

(4) The fuel costs, difficult to ascertain in this type of plant, appeared to be 25 per cent. higher than when melting iron, because if the furnace had been engaged on iron it would have been tapped in 2 hours. Taking Scott & Dawson's figure of "coal at 20s. per ton, plus 3s. for pulverising, 15 per cent. of the charge or 3s. 6d." Then our first estimate is 18.75 per cent. or 4s. 4½d. per ton. But there is still an allowance to be made for the smaller "steel" capacity as compared with "iron," so another 25 per cent., making 5s. 6d. all told. Obviously if linings are put in more frequently, there is the drying out, but surely 6s. 3d. should be ample on this basis.

(5) For the refractory costs, and again making reference to the Scott & Dawson figure (2s. 1d.), then 5s. should suffice.

(6) The cheapest raw materials were being converted into hot fluid steel eminently suitable for steel castings.

(7) The labour requirements were at a minimum for the operation of metallurgical furnaces.

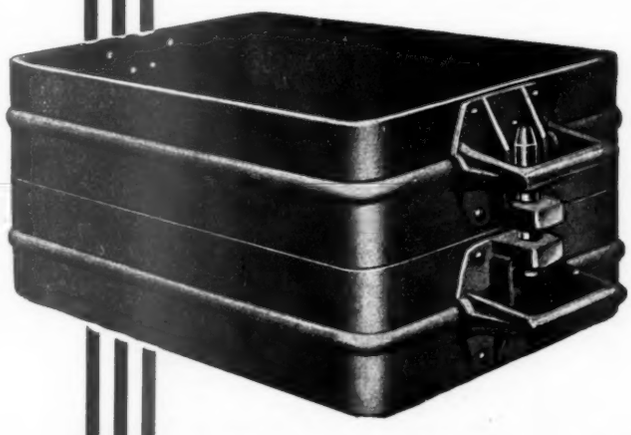
Conclusions.

We have constantly borne in mind that this is a new process, and have recalled to our minds the troubles we experienced when we were operating electric furnaces at a similar stage in their development, and we feel that there is a distinct field for the use of the rotary pulverised-fuel-fired furnace, not only in the steel foundry, but in the lighter-steel industry generally. "Snags," "teething troubles" and the like will be experienced, and perhaps some firms will fail to make good with it, as has been the case with the electric furnace and other processes. Much work of a purely metallurgical character still remains to be done. Is the steel as clean as electric? Are there more or less non-metallic inclusions? Will the steel exhibit any qualities of unreliability? Only time and added experience can answer these questions, but for the present the plant and process at Mons represent a development compelling the interest of all steel founders anxious to be armed with a knowledge of potential cost reduction.

Alloy Steels in U.S.—The following figures, taken from "The Iron Age," show that, in a survey taken over 23 years, alloy steels have made definite progress in spite of prevailing industrial conditions. In 1929 alloy steel production amounted to 7 per cent. of the total, and the lowest point recorded during the depression was 5.61 per cent. The production of alloy-steel castings in 1931 amounted to 6.17 per cent. of the total production of alloy steel, which is the best showing for 16 years. Electric furnace output of alloy steel reached 15.94 per cent. of the total alloy steel in 1931—the second highest on record.

STERLING MOULDING BOXES

are an essential part of the equipment of every up-to-date foundry



The Sterling Box is more than "just a Moulding Box," it is an accurate tool for producing accurate castings with a minimum of labour and effort

Made from solid ribbed rolled steel

STERLING FOUNDRY SPECIALTIES Limited
LONDON OFFICE:—13 VICTORIA STREET, S.W.1
AGENTS AT MANCHESTER, GLASGOW & NEWCASTLE-ON-TYNE.
BEDFORD

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	32	8	9
Three months	32	12	6
Electrolytic	36	10	0
Tough	33	10	0
Best selected	34	0	0
Sheets	68	0	0
India	45	0	0
Wire bars	36	15	0
Do., Nov.	36	17	6
Do., Dec.	37	0	0
Ingot bars	36	15	0
H.C. wire rods	40	0	0
Off. av. cash, September	35	0	7 37/44
Do., 3 mths., September	35	1	1 7/11
Do., Sttlmnt., September	35	0	6 9/11
Do., Electro, September	38	13	2 2/11
Do., B.S., September	37	4	2
Do., wire bars, September	39	0	0
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7⅝d.
Rolled metal	7½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£	s.	d.
Standard cash	151	10	0
Three months	152	12	6
English	153	7	6
Bars	153	5	0
Straits	155	0	0
Australian	153	7	6
Eastern	154	10	0
Banca	156	7	6
Off. av. cash, September	152	16	3
Do., 3 mths., September	154	7	7 4/11
Do., Sttlmt., September	152	16	1 7/11

SPELTER.

	£	s.	d.
Ordinary	14	17	6
Remelted	14	15	0
Hard	12	10	0
Electro 99.9	17	5	0
English	15	12	6
India	14	0	0
Zinc dust	22	0	0
Zinc ashes	2	5	0
Off. aver., September	15	10	8 33/44
Aver. spot, September	15	9	1 7/11

LEAD.

	£	s.	d.
Soft foreign ppt.	12	2	6
Empire	12	6	3
English	13	15	0
Off. average, September	13	4	8 13/22
Average spot, September	13	2	5 7/22

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whse.	22	10	0
Rods	27	0	0
Boiler plates	23	0	0
Battery plates		—	

ANTIMONY.

	£	s.	d.		£	s.	d.
English	35	0	0	to	42	10	0
Chinese					25	0	0
Crude					16	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	9	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£13 15 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10d. lb.
Ferro-phosphorus, 20/25%	£20 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£25 15 0
6/8% car.	£24 10 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£36 10 0
Max. 1% car.	£42 12 6
Max. 0.70% car.	£43 17 6
70% carbon-free	1/- lb.
Nickel—80/99.5%	£240 to £245
"F" nickel shot	£216 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£100 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 5/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.		£	s.	d.
Heavy steel					1	18	0
Bundled steel and shrngs.	1	15	0	to	1	17	0
Mixed iron and steel					1	15	0
Heavy cast iron	1	19	0	to	2	0	0
Good machinery					2	5	0
Cleveland—							
Heavy steel	1	12	6	to	1	15	0
Steel turnings					1	7	6
Cast-iron borings					1	2	6
Heavy forge					2	10	0
W.I. piling scrap					2	2	6
Cast-iron scrap	1	15	0	to	1	16	0
Midlands—							
Light cast-iron scrap					1	15	0
Heavy wrought iron					2	2	6
Steel turnings, f.o.r.					0	19	0
Scotland—							
Heavy steel					1	13	0
Ordinary cast iron					1	19	6
Engineers' turnings					1	7	6
Cast-iron borings					1	10	0
Wrought-iron piling					1	19	0
Heavy machinery					2	4	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	19	0	0
Lead (less usual draft)	11	0	0
Tea lead	9	10	0
Zinc	8	10	0
New aluminium cuttings	72	0	0
Braziery copper	23	0	0
Gunmetal	22	0	0
Hollow pewter	82	0	0
Shaped black pewter	65	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	59/6
Hematite M/Nos.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	70/-
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	70/-
„ No. 3	67/6
Hem. M/Nos. d/d	67/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/6
Clyde, No. 3	84/6
Monkland, No. 3	84/6
Summerlee, No. 3	84/6
Eglinton, No. 3	84/6
Gartsherrie, No. 3	84/6
Shotts, No. 3	84/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (or.)	9	5	0	to	9	15	0
Nut and bolt iron	7	15	0	to	8	10	0
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					12	0	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	7	6	to	9	5	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¼ in. (Untested)					6	12	6 & up.
Flats—3 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)					9	10	0
Black sheets, 24g.					8	5	0
Galv. cor. shts.					10	0	0
Galv. flat shts.	10	10	0	to	11	0	0
Galv. fencing wire, 8g. plain					12	17	6
Billets, soft	4	17	6	to	5	7	6
Billets, hard					6	12	6
Sheet bars	4	12	6	to	5	2	6
Tin bars	4	12	6	to	4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10¾d.
Sheet to 10 w.g.	11¾d.
Wire	11¾d.
Rods	10¾d.
Tubes	16¼d.
Castings	12¾d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
„ furnace	16/- to 16/6
Durham and Northumberland—	
„ foundry	21/- to 25/-
„ furnace	12/- to 12/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/-
„	28×20 „	32/-
„	20×10 „	24/-
„	18¾×14 „	16/6
C.W.	20×14 „	13/6
„	28×20 „	—
„	20×10 „	—
„	18¾×14 „	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Oct.	6 ..	32	13	9	dec. 18/9
,,	7 ..	32	10	0	,, 3/9
,,	10 ..	31	15	0	,, 15/-
,,	11 ..	31	15	0	No change
,,	12 ..	32	8	9	inc. 13/9

Electrolytic Copper.

		£	s.	d.	
Oct.	6 ..	37	5	0	dec. 10/-
,,	7 ..	36	15	0	,, 10/-
,,	10 ..	36	0	0	,, 15/-
,,	11 ..	36	0	0	No change
,,	12 ..	36	10	0	inc. 10/-

Standard Tin (cash).

		£	s.	d.	
Oct.	6 ..	149	2	6	dec. 42/6
,,	7 ..	148	17	6	,, 5/-
,,	10 ..	148	0	0	,, 17/6
,,	11 ..	149	7	6	inc. 27/6
,,	12 ..	151	10	0	,, 42/6

Tin (English ingots).

		£	s.	d.	
Oct.	6 ..	151	0	0	dec. 40/-
,,	7 ..	150	15	0	,, 5/-
,,	10 ..	149	15	0	,, 20/-
,,	11 ..	151	5	0	inc. 30/-
,,	12 ..	153	7	6	,, 42/6

Spelter (ordinary).

		£	s.	d.	
Oct.	6 ..	14	17	6	dec. 7/6
,,	7 ..	14	13	9	,, 3/9
,,	10 ..	14	10	0	,, 3/9
,,	11 ..	14	12	6	inc. 2/6
,,	12 ..	14	17	6	,, 5/-

Spelter (Electro, 99.9 per cent.).

		£	s.	d.	
Oct.	6 ..	17	7	6	dec. 2/6
,,	7 ..	17	2	6	,, 5/-
,,	10 ..	17	0	0	,, 2/6
,,	11 ..	17	5	0	inc. 5/-
,,	12 ..	17	5	0	No change

Zinc Sheets (English).

		£	s.	d.	
Oct.	6 ..	24	10	0	No change
,,	7 ..	24	10	0	,, ,,
,,	10 ..	24	10	0	,, ,,
,,	11 ..	24	10	0	,, ,,
,,	12 ..	24	10	0	,, ,,

Lead (English).

		£	s.	d.	
Oct.	6 ..	14	5	0	dec. 5/-
,,	7 ..	14	0	0	,, 5/-
,,	10 ..	13	15	0	,, 5/-
,,	11 ..	13	15	0	No change
,,	12 ..	13	15	0	,, ,,

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1894	0 12 6	0 12 6	0 12 7½	0 12 1½	0 12 4	0 12 1	0 12 0	0 12 0½	0 11 10½	0 12 2	0 12 0	0 12 0	0 12 1½
1895	0 12 0	0 12 0	0 11 10	0 12 0	0 12 0	0 12 3	0 12 3	0 12 4	0 12 4	0 12 6	0 12 7	0 12 6	0 12 2½
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 8
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8½
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8½
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 15 6	0 14 9	0 14 9	0 15 1	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9½
1905	0 15 3	0 15 6	0 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 3½
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2½
1908	0 16 6	0 15 0	0 15 6	0 15 6	0 15 3	0 15 0	0 15 0	0 14 9	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5½
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 0	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6½	1 1 3	1 1 5	1 0 9½
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0½	1 1 6½	1 0 7½
1912	1 2 3	1 2 6	1 2 6	1 1 1½	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2½
1913	1 2 9	1 2 2	1 1 7½	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5½
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1½	0 19 7½	0 18 11½	0 17 10½	0 18 7½	1 1 0½	0 18 5½
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1½
1916	1 18 6	2 0 1½	2 2 6½	2 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price Fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 13 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 16 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 6	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 13 8½
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9½	1 4 2½	1 3 3½	1 2 6	1 2 3	1 5 2½
1923	1 2 9½	1 4 6½	1 5 2	1 4 8½	1 4 6	1 4 0	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10½
1924	1 4 2½	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1½
1926	1 1 1½	1 1 6	1 1 0	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 6*	1 1 0*	1 1 6*	1 1 6*	*	1 1 4½
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 7½	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 7½
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 2½
1929	1 2 6	1 2 6½	1 2 11½	1 3 0	1 3 0	1 3 2½	1 4 0	1 4 8½	1 4 7½	1 4 6	1 4 6	1 4 3	1 3 7½
1930	1 3 3½	1 2 6	1 1 9	1 1 6	1 0 10½	1 0 0	1 0 0	0 19 6	0 19 0	0 17 4½	0 16 4½	0 16 4½	0 19 10½
1931	0 16 1½	0 16 0	0 16 0	0 15 11½	0 15 0½	0 14 10½	0 14 10	0 14 3½	0 14 6	0 16 8½	0 17 0½	0 16 6	0 15 9
1932	0 16 6	0 16 6	0 16 3	0 15 6	0 15 4½	0 15 0	0 14 11	0 14 8½	0 14 6	—	—	—	—

* Prices nominal.

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